TABLE OF CONTENTS

I. INTRODUCTION

II. COMPUTER PROGRAM DESCRIPTIONS

- 1. Centrifugal Flow Pump Sizing Program
- 2. Axial Thrust Balancer Stability Analysis
- 3. Circular Section Volute Design
- 4. Inducer and Impeller Performance Design
- 5. Impeller Discharge Traverse Data Evaluation
- 6. Pump Air Test Data Reduction
- 7. Overall Performance of a Two Stage LH₂ Pump
- 8. Crossover Passage Design
- 9. Air Pump Performance Map
- 10. Pump Axial Thrust Program
- 11. LH₂ Pump Test Data Reduction Program
- 12. Axial Blade Design Program
- 13. Multistage Axial Flow Turbine Performance Analysis Program

1. CENTRIFUGAL FLOW PUMP SIZING PROGRAM

COMPUTER PROGRAM

CENTRIFUGAL FLOW PUMP SIZING PROGRAM

I. INTRODUCTION

Preliminary sizing of a centrifugal flow pump is performed based on an assumed or initial hydraulic efficiency component losses are computed and a new value of efficiency is determined. Sizing and loss computations are repeate until the hydraulic efficiency approaches a constant value and the specified her is satisfied. With this program, a pump can be sized for a specified flow coefficient or the optimum flow coefficient can be determined by iterative process the selection of the appropriate program flag. Because of design model limitations this program is generally not recommended for final detail design.

This program was used for the design point selection of the NERVA two-staturbopump described in Reference 1.

Reference 1 - Aerojet Nuclear Systems Company Engineering Operations Report N8300R:71-076, NERVA Turbopump Design Report, Volume 1, September 1971

I. INTRODUCTION

During the design of the NERVA Turbopump, numerous computer programs were developed for the analyses of fluid dynamic problems within the machine. The programs developed are shown in the following list.

- 1. Centrifugal Flow Pump Sizing Program
- 2. Axial Thrust Balancer Stability Analysis
- 3. Circular Section Volute Design
- 4. Inducer and Impeller Performance Program
- 5. Impeller Discharge Traverse Data Evaluation
- 6. Pump Air Test Data Reduction
- 7. Overall Performance of a Two Stage LH₂ Pump
- 8. Crossover Passage Design
- 9. Air Pump Performance Map
- 10. Pump Axial Thrust Program
- 11. LH₂ Pump Test Data Reduction Program
- 12. Axial Blade Design Program
- 13. Multistage Axial Flow Turbine Performance Analysis Program

This report contains program descriptions, example cases, users instructions, and listings for the majority of these programs. In some cases only the listing is included.

II. COMPUTER PROGRAM DESCRIPTIONS

II. <u>DESIGN MODEL</u>

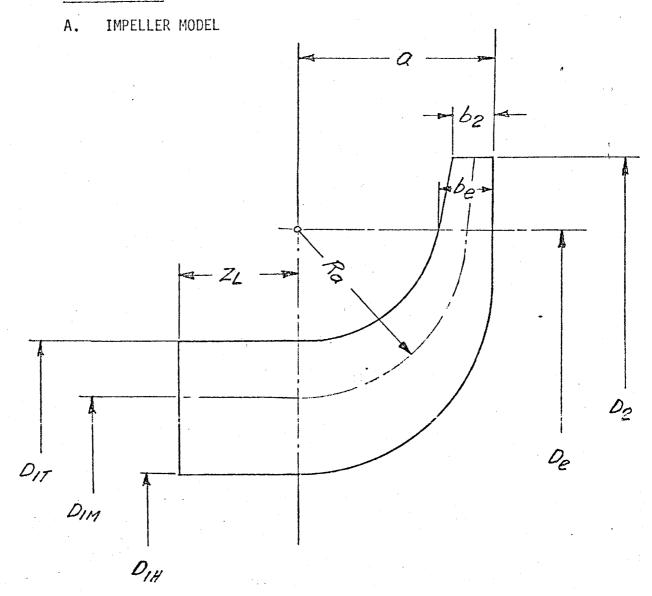


FIGURE 1

Refer to Figure 1:

$$D_{1H} = \int D_{1T}$$

$$D_{1M} = \left(\frac{D_{1T}^2 + D_{1H}^2}{2}\right)^{1/2}$$

$$D_{e} = D_{M1} + 2 R_{a}$$

$$b_{e} = \frac{D_{2}}{D_{e}} b_{2}$$

$$Z_{L} = \frac{\Pi}{Z_{0}} D_{1T} G_{IND} \sin (1.1 \beta_{T})$$

$$h_{1} = \frac{D_{1T} - D_{1H}}{2}$$

$$R_{a} = 1.5 \frac{h_{1} + b_{2}}{2}$$

$$R_{m1} = \frac{D_{m1}}{2}$$

If the inducer (axial section) is integral to the impeller the first partial blades are assumed to begin at the start of the transition section. The transition section is divided into 3 cones. The blade angle within each conical section is constant. The radial section contains logarithmic spiral blading $(\beta = \beta_2)$.

Blading of impellers without integral inducers begins at the start of the transition section. For such impellers the input parameters $Z_{\mathbf{0}}$ designating the number of inducer blades must be zero.

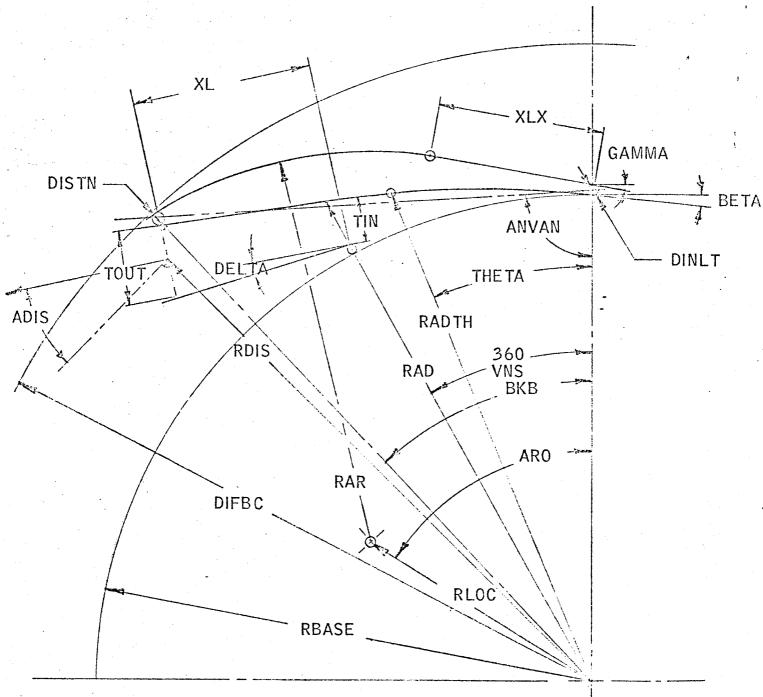
B. VANED DIFFUSER MODEL

The parallel wall vaned diffuser consists of vanes with straight line contours within the region of vane overlap. The vane shape is shown in Figure 2.

III. INSTRUCTIONS TO INPUT

- 1. The ratio QKI is the ratio of the impeller recirculatory flow to the net pump flow.
- 2. PHIMN is the limiting minimum value for the inlet tip flow coefficient.
- 3. The cavitation parameter VHKM is the ratio of the Net Positive Suction Head to the inlet velocity head.

DIFFUSER BLADE



CVAN = CHORD LENGTH

VNS = NUMBER OF VANES

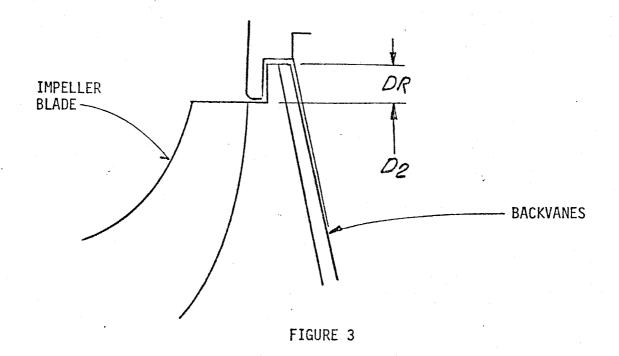
RDIS = RADIUS TO POINT OF MEAN DISCHARGE THROAT

ADIS = ANGLE OF DISCHARGE AT THROAT (MEAN ANGLE)

4. The first partial impeller blades designated by Z1 are the longest blades next to the full blades. The inducer blades Z0 which generally extend to the impeller discharge are considered as full blades & must be added to the partial blades to obtain the total number of impeller blades. Z2, Z3 and Z4 are splitter vanes or shorter partial blades. The value to be input for the blade schedule NZ is equal to the highest number of partial blades, e.g., for Z3 NZ = 3. The blade schedule for the 24 blade M-l oxydizer impeller, for instance, is:

Z = 24 total number of blades
Z0 = 3 full blades or inducer blades
Z1 = 3 first or long partial blades
Z2 = 6 second or intermediate partial blades
Z3 = 6 third or short partial blades.

- 5. The blade angle distribution factor KBMID is the ratio of the inducer discharge mean blade angle to the inducer inlet mean blade angle.
 For flat plate inducers with constant hub ratio KBMID = 1.0.
- The tip clearance factor SIG is generally 1.2.
- 7. To improve axial thrust balance the impeller disc is sometimes extended beyond the discharge mean diameter of the impeller, as indicated in Figure below. DR is the radial extension of the impeller disc.



- 8. Impeller configuration flag FLAG
 - 0 unshrouded with backvanes
 - 1 shrouded with backvanes
 - 2 unshrouded with smooth backside
 - 3 shrouded with smooth backside
- 9. The labyrinth clearance factor FLACO is the ratio of the radial labyrinth clearance to the labyrinth diameter.
- 10. The flow coefficient factor KPHI is the ratio of the desired flow coefficient to that recommended by Stepanoff in Reference 2. For unshrouded impellers KPHI is generally less than 1.0.
- 11. A desired flow coefficient can be input. This will override the program recommended value. If three values are input, e.g. three pumps will be calculated in the same run.
- 12. The ratio XKQD is the ratio of the diffuser recirculatory flow to the net pump flow.
- 13. The diffuser length to throat ratio is equal to XL/TIN (see Figure 2).
- 14. For the parallel wall diffuser, the diffuser area ratio REX is TOUT/TIN.
- 15. The diffuser blade shape and especially the thickness to chord length ratio varies significantly with blade number and blade angle. If these parameters are not specified (see note 17) the program searches for an acceptable blade shape within a range of blade angles and blade number limited by RLBET and RLZD. RLBET is the difference between the maximum allowable blade angle and the minimum calculated value (generally approximately 2 to 3 degrees). RLZD is the maximum diffuser blade number specified. The acceptance criteria for the blade profile is incorporated into the main program.
- 16. Flag OPTFI = 1.0 if discharge flow coefficient optimization is desired.
- 17. SBETA and SZD are optional. If not input RLBET and RLZD must be specified in order that a low loss diffuser vane may be selected from a sample of vane shapes (see also Note 15).

Reference 2

Stepanoff, A. J. - Centrifugal and Axial Flow Pump, John Wiley & Sons, 1957

- 18. If the friction loss coefficient FRD is input it will override the program calculated friction coefficient based on the vane surface finish (see Note 21).
- 19. Diffuser loss adjustment factor FLACO \sim 2.25. Value can be zero if a continuous crossover channel is used.
- 20. Optional housing structural constraints: RPHG, FSTHG & SSTHG.
 All these parameters must be either zero or positive.
- 21. XKFVD must be input if FRD is zero.
- 22. FLAHG HOUSING TYPE DEFINITION
 - 1.0 Single Discharge Single Tongue Vol. (no vaned diffuser)
 - 2.0 Dual Discharge Volute (no vaned Diffuser)
 - 3.0 Double Volute (no vaned diffuser)
 - 4.0 Vaned Diffuser, Single Discharge Single Tongue Volute
 - 5.0 Vaned Diffuser, Dual Discharge Volute
 - 6.0 Vaned Diffuser, Double Volute
 - 7.0 Vaned Diffuser + Crossover Channel with vaneless
 - 8.0 Vaned Diffuser + Reversing channel with continuous vane
- 23. The following parameters are related to internal crossover designs defined by housing type definition flags (FLAHG) 7.0 and 8.0:

Friction Loss Coefficient for vaneless turn CLUT (FLAHG = 7.0). For cast channels CLUT \approx 0.04. This value is lower for machined channels.

The angle correction factor FINC applies to the inlet angle of the reversing vanes (FLAHG = 7.0). FINC is the ratio of vane inlet angle to fluid angle at the inlet to the vane.

A fluid angle BE10 at the reversing vane discharge of 90° indicates that the fluid exits the vaned passages in radial direction.

The number of reversing vanes ZRV is related to the number of diffuser vanes in the program. The program determined value is overridden when ZRV is input.

The reversing vane discharge disameter D9 is related to the impeller eye diameter in the model. The program determined value is ignored if D9 is input.

The vane height B9 is indicated in Figure 4 and related to B7 in subroutine REVCH.

The ratio RBRM = r_m/B_m (Figure 4) is optional. If input it will override the program constant of 1.4.

The program constant for RB67 of 1.1 can be circumvented by inputting a specified value.

The inlet blade thickness THRV applies to housing configuration (FLAHG) 7. If input it will override the program value of 0.120.

The program constant for RDSV is 1.1.

SUMMARY OF RUN MODES IV.

- With all optional parameters specified, e.g. discharge flow coefficient, 1. diffuser blade number and angle.
- As above with as many as 3 flow coefficients for evaluation purposes. 2.
- Flow coefficient in percent of Stepanoff's recommended value, with 3. or without specified diffuser parameters.
- Flow coefficient optimization, no options. 4.

NOMENCLATURE INPUT

SYBMOL	DESCRIPTION	UNITS	FORMAT
WP	Flow Rate	lb/s	F
XN	Rotational Speed	RPM	F
RH0	Fluid Density	lb/ft ³	F
QKI (1)*	Ratio Recirc. Flow Impeller	-	F
HNPSH	Net Positive Suction Head	ft	F
НТОТ	Tot Head Required	ft	F
EPS	Inlet Hub Ratio	•	F
PHIMN (2)*	Impeller Inlet Min Flow Coefficient	•	F
BB2	Impeller Discharge Blade Angle	Deg	F
VHKM (3)*	Min Cavitation Parameter	•	F
SOLI	Inducer Blade Solidity	gran .	F
ZO	Inducer Blade Number	-	F
Z1 (4)*	First Partial Impeller Blades	***	F
Z2 (4)*	Second Partial Impeller Blades	**	F
Z3 (4)*	Third Partial Impeller Blades	· -	F
Z4 (4)*	Fourth Partial Impeller Blades	-	F
KBMID (5)*	Blade Angle Distribution Factor		F
NZ (4)*	Blade Schedule		I
SLC	Blade Tip Clearance	In	F
SIG (6)*	Tip Clearance Loss Factor		F
DR (7)*	Radial Extension of Impeller Disk	In	F
FLAG (8)*	Impeller Configuration		F
FLACO (9)*	Labyrinth Clearance Factor	-	F
KPH1 (10)*	Flow Coefficient Factor	-	F
PHI21 (11)*	Selected Discharge Flow Coefficient		F
PHI22 (11)*	Selected Discharge Flow Coefficient	-	F
PHI23 (11)*	Selected Discharge Flow Coefficient	-	F
ETAHI	Initial Hydraulic Efficiency	•	F .
Z	Total Number of Impeller Blades		F
XKQD (12)*	Ratio Recirc. Flow Diffuser	•	F
DINLT	Diffuser Inlet Blade Thickness	In	·F
RL (13)*	Diffuser Length to Throat Ratio	**	F
REX (14)*	Diffuser Area Ratio	•	F

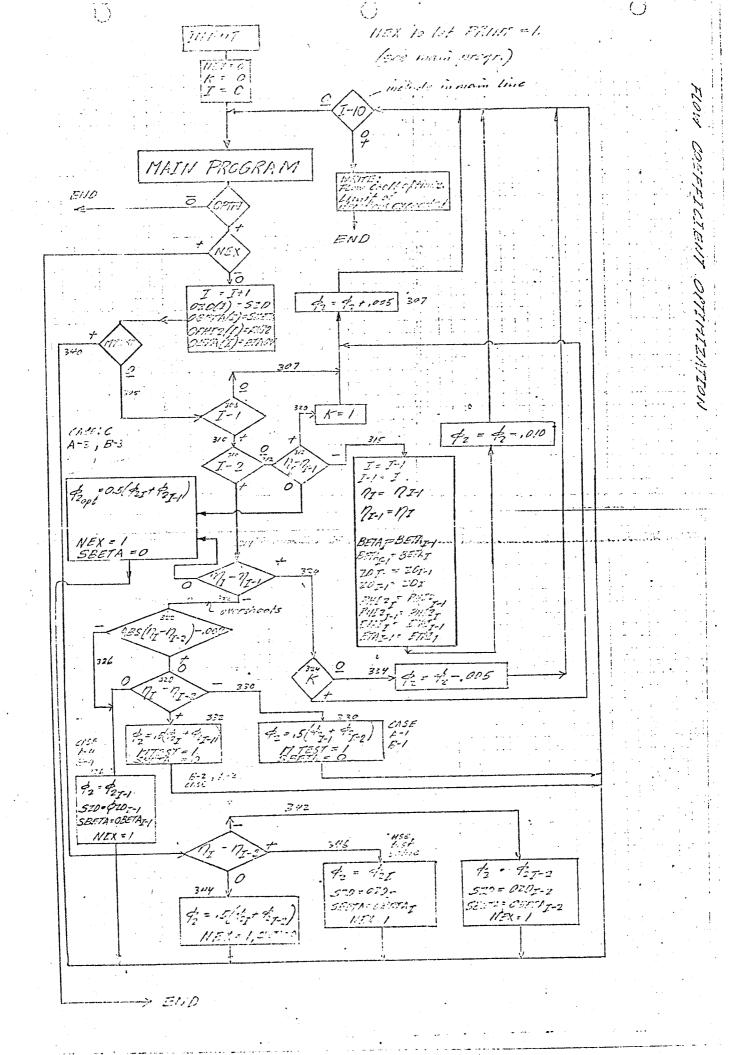
SYMBOL	DESCRIPTION	UNITS FORMAT
RLBET	(15)* Range Diffuser Inlet Blade Angle	- F
RLZD	(15)* Max. Diffuser Blade Number	- F
XKMSC	Surface Finish, Impeller	In E,
OPTFI	(16)* Flow Coefficient Optimization Flag	- F
SBETA	(17)* Selected Diffuser Blade Inlet Angle	Deg F
SZD	(17)* Selected Diffuser Blade Number	- F
FRD	(18)* Friction Coefficient Diffuser	- F
FLA	(19)* Diffuser Loss Adjustment Factor	- F
RPHG	(20)* Max to Design Pressure Ratio	- F
FSTHG	(20)* Housing Safety Factor	- F
SSTHG	(20)* Housing Material Yield Strength	1b/sq in F
VIS	Fluid Dynamic Viscosity	<pre>1b sec/sq ft E</pre>
	en e	
XKFVD	(21)* Surface Finish Diffuser Vane	In E
XKDVD	Diffusion Loss Factor (\sim .260)	- F
XKIAD	Incidence Loss Factor (\sim .300)	- 20 g − g F
EVD	Diffusion Exponent Diffuser (∼3.0)	- F
FLAHG	(22)* Housing Type Definition	- F
XKSFS	Volute Surface Finish	In E
CLUT	(23) * Friction Loss Coeff, Vaneless Turn	- F
FINC	(23)* Angle Correction Factor	F • • • • • • • • • • • • • • • • • • •
BE10	(23) Fluid Angle, REversing Vane Discharge	Deg F
ZRV	(23) * Number of Reversing Vanes	- F
D9	(23) * Reversing Vane Discharge Dia	In F
B9	(23)* Vane Height, Revers Vane Discharge	In F
RBRM	(23) Ratio Mean Turning Radius to Mean Passage He	eight F
RB67	(23)* Ratio B6/B7	- F
THRV	(23) Inlet Blade Thickness	In F
RDSV	(23) ★ Ratio DSV/D9 (~1.1)	- F .

^{*}Note number, see Instructions Section III.

NOMENCLATURE OUTPUT

·			UNITS
	DESCRIPTION		In
SYMBOL	See Figure 1	•	In
RA	a Figure 1		In .
RC	Axial Length of Inducer Section		•
ZL	AX1a1 Lengan		In
	Chord Length, Inducer		Deg
CLIND	T-ducov		In.
THIND	Blade Wrap Inducer Hydraulic Diameter Inducer Blade Passage	Section 1985	In
DHIND	I chowd length		In
CLTOT	Radius Locating 2nd Partial Blade		- ·
RP2	Total Solidity		
SOLT0	Total Solver		In
	Chord Length Impeller		Deg
CLIMP	77 -10		In.
THIMP	Blade Wrap Impeller Hudraulic Diameter Impeller Blade Passage		Deg
DHIMP	plade Wrap		-
THTOT	saula solidity 1st-2nd Partial		In
SOL2	Hydraulic Dia. 1st-2nd Partial		
DH2	nyara.		Deg
	Blade Angle Cone l		Deg
BBC1	Blade Angle Cone 2		Deg
BBC2	Blade Angle Cone 3		· In
BBC3	niamoter Total		* · · · •
DHTOT	na do colidity 2nd-3rd raitia.	• •	In.
SOL3	Hydraulic Dia. 2nd-3rd Partial		
DH3			In
	Chord Length Radial Section		In
CLRS	Chord Length Cone 1		In
CLC1	Chord Length Cone 2	•	In
CLC2	Chord Length Cone 3		In
CLC3	Chord Length Total		-
CLTS	Impeller Blade Solidity		
SOLIP	****F =	•	

SYMBOL	DESCRIPTION			UNITS
THRS	Blade Wrap Radial Section			Deg
THC1	Blade Wrap Cone 1			Deg
THC2	Blade Wrap Cone 2		•	Deg
THC3	Blade Wrap Cone 3			Deg
THTS	Blade Wrap Total			Deg
SCL	Blade Tip Clearance	•		In
DELE	Clearance Loss Parameters			
DELK	Clearance Loss Parameter			-
DELR	Clearance Loss Parameter			-
W2TH	Discharge Relative Velocity			ft/sec
RW	Relative Velocity Ratio			-
нтн	Theoretical Head			ft
SLPCF	Slip Coefficient			
PSINC	Head Loss Coefficient Inducer			-
PSF	Head Loss Coefficient Friction			- ,
PSD	Head Loss Coefficient Diffusion			-
PSTIP	Head Loss Coefficient Tip			-
PSCL	Head Loss Coefficient Clearance			•
PSIBL	Head Loss Coefficient Blade			· •
PSITH	Theoretical Head Coefficient			-
Parameters o	describing diffuser blade geometry ta:	are depicted	in Figure 2.	Other
STANG	Stagger Angle			Deg
TRACO	Chord Length(Transformed)			In.
SOLID	Solidity			
BBM4	Inlet Mean Blade Angle			Deg
BBM5	Exit Mean Blade Angle			Deg
FEE	Blade Turning Angle		ř	•
ACROSS	Blade Cross-sectional Area			in ²
AEW	Passage End Wall Area			in ²
ABS1	Blade Surface Area			In ²
AR	Ratio AEN/(Z x ABS1)			2
DH	Hydraulic Diameter			in ²
ATHT	Total Throat Area			in ²



```
W ELT ANSWR,1,710427, 53088
000001
                         SUBROUTINE ANSWR
000002
                         REAL KEMID .
                         COMMON
                                   XK(8), XZ(8), XFR(8), XR(8)
000003
300004
                         COMMON DHIRMI, H.RA.RC. BBMI, CLIND, THIND, ZL. PHIND, BLK1, A1, AB1, DPIND
000005
                        1,8801)RBC2.BBC3.CLC1.CLC2.CLC3.CLTS.THC1.THC2.THC3.THTS.CLRS.THRS.
000006
                        2CLIMPOTHIMPOCLTOT. THTOT. BLK2. A2. SOL1. SOL2. SOL3. SOL4. SOL5. SOLIP. SOL
                        3TO.OHE.D-13.DH4.DH5.DHIMP.DHTOT.RP2.RP3.RP4.SM.OI.SIG.DR.CM2.SCL
000007
800008
                        CONMON DT1:EPS:D2:B3:B3T1:BB2:Z:Z0:Z1:Z2:Z3:Z4:NZ:KBMID:XSI:DPIMP
                         COMMON WP.XN.RHO.QKI.HNPSH.HTOT.PHIMN.VHKM.ETAHI.PSITH.ESHR.RWR
000009
060010
                         COMMON XKPH1, PHI21, PHI22, PHI23, CM1, UT1, PHI1T, S, XNS, PSIO, PHI2, NCASE
000011
                         COMMON FLAG, VIS, FLACO, WWR, U2, PSIBL, DPIPS, PSIIP, PSIIN, FRD
000012
                         COMMON B4.RL.REX.R4.BETA.BFL4.ZD.DINLT.DISTH.TIN.TOUT.XL.V5.
000013
                        TRADUS (95), THETA, RADTH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN,
000014
                        2ANVAN#BKB.DIFBC.RDIS.ADIS.THICK.THICO.STANG.TRACO.SOLID.BBM4.
000015
                        38845, FEE, ACROS, AEW, ABS1, DH, AR, ATHT , RI, NOGO, NSKIP, OPTFI, PRINT, FIR
000016
                         COMMON RIOPT.RIBM.RIBL.RIBH.DEL.BFL5.DEQ.RMTH.OMPR.OMEW.OMOV
000017
                         COMMON V4+M+
                                                XKDVD, XK1VD, XKFVD, EVD, FLA, XK0D, 0, QD, OMTOT
000018
                         COMMON RPHG.SSTHG.FSTHG.XKSFS.XKMSC.D6.D7.C7.DPSSC.DPSFS.DPSMC.C34
000019
                         COMMON RUBET, RUZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, B9
000020
                         COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5
000021
                    110 FORMAT(1X, INLET HUB DIAMETER, DH1 1, 13X, F10, 3, 2X, INCHES, 10X, INLE
000022
                       7T MEAN RADIUS, RM1, 14X, F10.3, 2X, INCHES!)
                                                                                                     Land Market
000023
                     111 FORMAT(1X, 'INDUCER VANE HEIGHT, H', 14x, F10.3, 2X, 'INCHES', 10X, 'INLET
                        8 AREA, A11, 22X, F10.3, 2X, 'SQ IN')
000024
                     112 FORMAT(1X, INLET BLOCKAGE, BLK1', 16X, F10.3, 3X, ****, 12X, INDUCER DI
000025
000026
                       1FF PARAMETER DPIND 1,7X ,F10.3,3X , 1****1)
000027
                     113 FORMAT(1X,*INLET AREA WITH BLOCKAGE+AB1*,7X,F10.3,2X,*SQ IN*,11X,*
000023
                        1DISCHARGE AREA, A21, 18X, F10.3, 2X, 'SQ IN')
000029
                     114 FORMAT(1X,*INLET MEAN BLADE ANGLE,88M1*,8X,F10.3,2X,*DEGREES*)
000030
                    115 FORMAT(1X; *IMPLER DIFF PARAMETER, DPIMP*, 8X; F10.3; 3X; *****, 12X; *DIS
000031
                        2CHARGE BLOCKAGE . BLK2 . . 12X . F10 . 3 . 3X . 1 *** 1)
010032
                     116 FORMAT(1X, INLET TIP TO DISCHARGE DIA RATIO, XSI, F9.3, 3X, *****, 12X
                        1, 'STATIC MOMENT, SM', 19x, F10, 3, 2x, 'SQ IN', /)
000033
                                                                                     =,F10.3,5X
060034
                    117 FORMAT(5X)7HRA
                                            = F10.3,5X,7HRC
                                                                = .F19 . 3 . 5X . 7HZI.
000035
                        1.7HCLRS =: F10.3.5X.7HTHRS =: F10.3)
                    118 FORMAT(5X,7HCLIND =:F10.3,5X,7HCLIMP =:F10.3,5X,7HBBC1
                                                                                     =,F10.3,5X
000036
                        1,7HCLC1 =,F10.3,5X,7HTHC1 =,F10.3)
000037
000038
                    119 FORMAT(5X,7HTHIND =,F10.3,5X,7HTHIMP =,F10.3,5X,7HBBC2
                                                                                    =,F10,3,5X
000039
                        1.7HCLC2 = .F10.3.5X,7HTHC2 = .F10.3)
000040
                    120 FORMAT(5X.7HDHIND =.F10.3.5X.7HDHIMP =.F10.3.5X.7HBBC3 =.F10.3.5X
                        1,7HCLC3 =,F10.3,5X,7HTHC3 =,F10.3)
000041
                    121 FORMAT(5X,7HCLTOT =,F10.3,5X,7HTHTOT =,F10.3,5X,7HDHTOT =,F10.3,5X
000042
000043
                        1.7HCLTS =:F10.3.5X.7HTHTS =:F10.3)
000044
                         WRITE (3,114) BBM1
                         WRITE(3,110) DH1,RM1
000045
000046
                         WRITE (3,111) H,A1
000047
                         WRITE (3, 112) BLK1, DPINO
000048
                         WRITE(3,113) AB1,A2
000049
                         WRITE(3,115) DPIMP, BLK2
000050
                         WRITE(3,116) XSI,SM
                         WRITE(3,117) RA,RC,ZL,CLRS,THRS
000051
                         WRITE(3,118) CLINO, CLIMP, BBC1, CLC1, THC1
000052
                         WRITE(3,119) THIND, THIMP, BBC2, CLC2, THC2
000053
                         WRITE(3,120) DHIND, DHIMP, BBC3, CLC3, THC3
€00054
                         WRITE (3,121) CLTOT, THTOT, DHTOT, CLTS, THTS
000055
```

000056

IF(NZ-2) 10,11,12

	DATE 28 APP 72 PAGE 5
000057	6 FORMATISX. SOLIP = + F10.4.5X. SOLTO = + F10.4)
000058	10 WEITE (3,6) SOLIP, SOLTO
000059	60 70 30
000060	.22 FOR MAT (5X,7HRP2 =,F10.3,5X,7HSOL2 =,F10.3,5X,7HSOL3 =,F10.3,5X
000061	1,7H30.IP =,F10.3/5X,7HS0LT0 =,F10.3,5X,7H0H2 =,F10.3,5X,7H0H3
000062	2=,719,33
000063	11 WRITE (3,22), RP2, SOL2, SOL3, SOLIP, SOLTO, DH2, DH3
000065	60 10 30 12 1F(YZ-3) 13,13,14
000065	24 FORMAT(5X,7HSOL2 =:F10.3,5X,7HSOL3 =:F10.3,5X,7HSOL4 =:F10.3,5X
-000088 -00006 7	3.7HRP? =:F10.3.5X.7HRP3 =:F10.3/5X.7HSOLIP =:F10.3.5X.7HSOLTO
000068	4=\F10.3,5X,7HDH2 =:F10.3,5X,7HDH3 =:F10.3,5X.7HDH4 =:F10.3)
000069	13 WR(TE(3,24); SOL2,SOL3,SOL4,RP2,RP3,SOLIP,SOLTO,DH2,DH3,DH4
000070	60 To 30
000071	27 FORMAT(5x,7HRP2 =:F10.3,5x,7HSol2 =:F10.3,5x,7HSol3 =:F10.3,5X
000072	1,7HDH2 =:F10.3,5X,7HDH3 =:F10.3/5X,7HPP3 =:F10.3,5X,7HSOL4
000073	2=,F10-3,5X,7HS0L5 =,F10-3,5X,7HDH4 =,F10-3,5X,7H9H5 =,F10-3/5
000074	3x,7HRP3 ==F10.3,5X,7HS0LIP =:F10.3,5X,7HS0LT0 =:F10.3)
000075	14 WRITE (3,27) RP2, SOL3, DH2, DH3, RP3, SOL4, SOL5, DH4, DH5, RP3, SOLIP,
000075	1SOLTO
000077	30 RETURN
000078	END
4.1	
•	
and the second s	
Companies and Security State of the Companies of the Comp	
production of the contract of the	
•	
- /	

024.13.722.50.21.100. DATE 28 APR 72 PAGE 6 @ ELT ASIN. 1,710427, 6:089 FUNCT!ON ASIN(A) 000001 IF(A) 1.2.2 1 SIGN=-1. GO TO 3 2 SIGN=1. 3 ASIN=ATAN(1,/SQRT(1,/A**2-1.))*SIGN 200000 000003 **0**000004 000005 000**006** 0000**07** RETURN) END 000008

```
@ ELT CLAB, 1, 710427, 63091
   000001
                            SUBROUTINE CLABI
   200000
                            COMMON XK(8) \cdot XZ(8) \cdot XFR(8) \cdot XR(8)
   000003
                            COMMON DH1 + RM1 + H + RA + RC + BBM1 + CLIND + THIND + ZL + DHIND + BLK1 + A1 + AB1 + DPIND
                           1,DBC1,BBC2,BBC3,CLC1,CLC2,CLC3,CLT5,THC1,THC2,THC3,THT5,CLRS,THRS,
  TC00004
                           2CLIMP.THIMP.CLTOT.THTOT.BLK2.A2.SOL1.SOL2.SOL3.SOL4.SOL5.SOLIP.SOL
   000005
                           3TO.CH2.DH3.DH4.DH5.DHIMP.DHTOT.RP2.RP3.RP4.SM.QI.SIG.DR.CM2.SCL
  000006
                            COMMON DT1, EPS, D2, B2, BBT1, BB2, Z, Z0, Z1, Z2, Z3, Z4, NZ, KBMID, XSI, DPIMP
  000007
  000008
                            COMMON WP.XN.RHO.QKI.HNPSH.HTOT.PHIMN.VHKM.ETAHI.PSITH.ESHR.RWR
  000009
                            COMMON XKPH1, PHI21, PHI22, PHI23, CM1, UT1, PHI1T, S, XNS, PSIO, PHI2, NCASE
  090010
                            COMMON FLAG, VIS: FLACO, W .U2.PSIBL.DPIPS, PSIIP.PSIIN.FRD
   000011
                            COMMON B4+RL+REX+R4+BETA+BFL4+ZD+DINLT+DISTH+TIN+TOUT+XL+V5+
                           1RADUS (95) - THETA' RADTH - ALPHA - RAD - DELTA - GAMMA - ARO - RAR - RLOC - CVAN -
  000012
                           ZANVAN, BKB, DIFBC, RDIS, ADIS, THICK, THICO, STA 16, TRACO, SOLID, BBM4,
  000013
                           3RBM5, FEE, ACROS, AEW, ABS1, DH, AR, ATHT , RI, NO 30, NSKIP, OPTFI, PRINT, FI2
  000014
  000015
                            COMMON RIOPT, RIBM, RIBL, RIBH, DEL, BFL5, DEO, RMTH, OMPR, OMEW, OMOV
0000167
                            COMMON V4.M.
                                                    XKDVD.XK1VD.XKEVD.EVD.FLA.
                                                                                  XKQD, Q, QD, QMTOT
  000017
                            COMMON RPHG:SSTHG:FSTHG:XKSFS:XKMSC:D6:D7:C7:DPSSC:DPSFS:DPSMC:C34
   000018
                            COMMON RUBET, RUZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, 89
  000019
                            COMMON CLUT, FINC, BE10, RBRM, D9, RB67, THRV, ZRV, RDSV, TEX5, DLDM, BCM5
  000020
                            R2=D2/2.
  000021
                            RT1=DT1/2.
  000022
                            D=2. ×RWR
   000023
                            CO=FLACO*D
  000024
                            PI=ESHR/16.
  000025
                            T=.030
   000026
                            XNTH=5.
  000027
                            DPFF=-1645E-07*-025*RH0*XN**2*(R2**2-RT1**2)
  000028
                            P=DPIPS-DPFF
   000029
                            VI=VIS*(32.16/RHO)
  000030
                            COEC=.67
                            FA=2.*RH0*32.1741*P*144.
  1000031
                            FB=SORT(FA)
   000032
                            5=3.1416*CO*(D+CO)/144.
  000033
  000034
                            CF=(XNTH-1.)*(1.-8.52/((PI-T)/CO+7.23))+1.
   000035
                            DO 40 I=1,3
  000036
                            COE=COEC/SQRT(CF)
  000037
                            W=COE*S*FB
   000038
                            RE=CO*W/(6.*S*VI*RHO)
  000039
                            ZLAB=T/CO
  000040
                            IF(RE-60.)200,200,300
   000041
                       200 RZ=ZLAB/RE
  000042
                            CALL INT4(XZ+XK+RZ+FK)
                            COEC=1./SORT(64./RE+48.*ZLAB/RE+FK)
  000043
   000044
                            GO TO 40
   000045
                       300 RE=ALOG(RE)
  000046
                            CALL INT4(XR, XFR, RE, FFR)
   000047
                            FFR=EXP(FFR)
                            RE=EXP(RE)
   00.0048
                            COE0=.62*RE**.0085
   000049
   000050
                            IF(ZLAB-1.15) 310,310,320
   000051
                       310 F=0
                            GO TO 330
   099052
   000053
                       320 F=1.-2.7183**(-.95*(ZLAB-1.15))
   000054
                       330 TF(RF-6000.)340.340.350
   000055
                       340 COEC=1./SQRT(1/COEO**2-F*(2*SQRT(1/COEO**2-64./RE)-2.)+2.*FFR*ZLAB
   000056
```

DATE 28 APR 72 PAGE

auth. 11 - - 2-1150 - 1 - 100

	matth 1 1 2 cg 50 + 1 + 100	ATE 28 APR 72 PAGE 3
000057	60 10 40	•
000057	350 CGE1=1./SQRT(1./CGE0**2-(2./CGE0-2.)*F+2.*FFR*ZLAB)	
000059	40 CONTINUE	in the graph of the state of th
000060	IF(PRINT) 50.50.60	T Marrie v. A
000061	60 WRITE(3,27)	
900062	WRITE(3:29) D	
000063 000064	WRITE(3,31) CO WRITE(3,33) XNTH	
000065	WRITE (3.37) PI	
000005	WRITE(3,39), T	
000067	WRITE(3,41) P	
000068	WRITE(3,15) W	
000069	27 FORMAT (/SX+1*** LABYRINTH DATA ****/)	
000070	29 FORMAT(5X, LABYRINTH DIAMETER, D:.33X,F10.4,2X, IN') 31 FORMAT(5X, RADIAL CLEARANCE, CO:,34X,F10.4,2X, IN')	
000072	33 FORMAT(5x, *NUMBER OF TEETH, XNTH*, 33x, F10.4, 2x, *****)	
000073	37 FORMAY(5X, 'TOOTH SPACING, PI', 37X, F10.4, 2X, 'IN')	1
000074	39 FORMAT(5X, 'TOOTH WIDTH, T', 40X, F10, 4, 2X, 'IN')	
000075	41 FORMAT(5x, PRESSURE DROP, P: 38x, F10.4, 2y, LB/SOIN')	
000076 , 000077	15 FORMAT(5X, LABYRINTH FLOW RATE, WWR, 30X, F10.4, 2X, LB/SEC, 50 RETURN	
000078	END	
		•
	$oldsymbol{v}_{i}$	
		and the second s
•		
., .,	•	
		·
	· · · · · · · · · · · · · · · · · · ·	

DATE 28 APR 72 PAGE (milling Res 28 x 50 + 1 + 100) @ ELT CUFIT:1,710427, 53094 ير زر ومطيعة SUBROUTINE CUFIT (MINUMBRIXIYIC) 000001 000002 DIMENSION X(10),Y(10),A(11,11),B(11),C(11),P(20) 000003 MX2=2 *M 000004 DO 13 I=1 MX2 000005 P(I)=0.0 DO 13 J=1 NUMBR 000006 1000007 13 P(1)=P(1)+X(J)**1 N=M+1800000 000009 DO 30- I=1.N [9000**10**] 00 30 J=1.N 000011 K=I+J-2 000012 IF (K) 29,29,28 000013 28 A(I,J)=P(K) 000014 GO TO 30 000015 29 A(1:1)=NUMBR 30 CONTINUE 000016. 000017 B(1)=0.0 DO 21 J=1.NUMBR 000018 000019 21 B(1)=B(1)+Y(J) 000020 DO 22 I=2.N 000021 B(I)=0.0 000022 DO 22 J=1.NUMBR 000023 22 B(I)=B(I)+Y(J)*X(J)**(I-1) 000024 NM1=N-1 000025 DO 300 K=1.NM1 KP1=K+1 000026 L=K 000027 DO 400 I=KP1.N 7000028 000029 'IF (ABS(A(I,K))-ABS(A(L,K))) 400,400,401 000030 401 L=I 000031 400 CONTINUE 000032 IF (L-K) 500,500,405 000033 405 DO 410 J=K,N 000034 TEMPEA(KIJ) 000035 $A(K_*J)=A(L_*J)$ 000036 410 A(L,J)=TEMP 000037 TEMP=B(K) 000038 B(K)=B(L) 000039 B(L)=TEMP 000040 500 DO 300 I=KP1.N 000041 FACT=A(I,K)/A(K,K) 000042 A(I+K)=0.0 DO 301 J=KP1.N 000043 000044 301 A(I,J)=A(I,J)-FACT*A(K,J) 000045 300 B(I)=B(I)-FACT*B(K) $C(N) = B(N) / A(N \cdot N)$ 7000046 000047 I=NM1 000048 710 IP1=I+1 000049 SUM=0.0 000050 DO 700 J=IP1.N 000051 700 SUM=SUM+A(I,J)*C(J) 000052 C(I)=(B(I)-SUM)/A(I,I)000053 I=I-1 IF(I) 800,800,710 000054

000055

000056

800 RETURN

END

·	FLVLD=(2.*KBASE-D2)/(2.**SIN(ALPH4))	95000
	BBW#=2VAE	
	Z**(1	
	OMID=XKIAD*(COS(BEF#))**5*(SIN(BEF#)\COS(BEF#)-ZIN(BBW#)\COS(BBW#)	£8000
	BBM¢=VZHE	
. 1	SAVE=88M4	15000
	V2HE=ATAN(I/PSIA*(RBASE/DIFBC)**2*1/SIN(BFLS)+SIN(BBM4)/COS(BBM4))	09000
· · · · · · · · · · · · · · · · · · ·	DZIV=EXb(-5**e*2IN(5**e)\\YD)*EXb(\\)\((\S**c)**(\dota*c\\X\\YD)))	61:000
	(*1	
		Z+1000
	T-C**3**2**2\Z3**2**2**2**2**0\Z3**3**0**2**0**6\Z3**2**0**0**0**0**0**0**0**0**0**0**0**0*	95000
	C=CO2(e)	
	\$\dagger{\pi}\$	
	OMDD = 0.0*(T/AC/Act) + (1/AC/Act) + (1/ACC) + (1/AC) + (1/	ht000
•	_OWED_=_EBD*(BC*IIY+DCDV+3*IT1S3*BBPSE\SD)*B\D**S\(r**DHD)	<u>£</u> 5000
	BEF2=(60*-8CW2)\2\.596	03045 51
	60 10 23	. Th000
	OMDD=XKDAD*DAD*EAD	01:000
	TW#)\CO2(BBW#)-BBW2E\DI=BC*ZIN(BEF2)\CO2(B=F2))	
	1041) VOICE (BOWLET OF THE CONTROLL OF THE CON	82000
	DAD=I*-BBV2E\DIEBC*CO2(8BW#)\CO2(BBW#)\(S**20FD)*(ZIN(8B	
	_OMFD=FRD *TRACO*RVD**2\(4.*ΦΗD)	7£000
	BFL5=BFL5/57•296	
	IE(ETVHG-7.) S2.22.21	95000
Control of the Contro	PBWd=BBWd72X*S66	0003t
	BFL4=8FL4/57.296	000022 50
	EBD=1.\(0.86858*ALOG(2.*DHD/XKFVD)+1.7740)**2	
•	60 10 20	12000
	FRD=0.0032+0.221/RED**0.237	
	IE(KED-1.E+05) 12.12.13	
	IF (FRD) 10.10.20	
	VS = VTH*TIN/TEXS	
	9 01 09	
	_A2=	25 25
	IE (ELAHC-7.) 32,32,34	0005¢
	SINOCATACHA*VIHA*VIHA*VIDEC	00003
	RVD=VTH/V4	00055
	TH = .121*05/(ZD*82*TIN)	00051
	VL2H4=(60*-8FL4)/57*296	00000
		=
	COMMON CLUTFING. BELO. PRR. D9. RB67. THRV. ZRV. RDSV. TEX5 . DLDM. BCM5	61000
	COMMON SEBET. REZD. SBETA. SZD. PSHSG. ETAOV. LOOP. FLAHG. 89	81000
	COWMON BEHG! 221HG!E21HG!XK2E2!XKW2C!DQ!D4:C4!DB22C!Db2E2!Db2WC!C2#	21000
; /	COMMON ARTHER XKDAD*XKTAD*XKEAD*EFF* XKGD*G*GQ*GMIGI	, 91000
·	COWWON BIOBI'SHBM'SIBF'SERY DEFY DEFY DECY GWITH OWEST OWEN OWON	91000
	PERMINE LEE VCKOZ VEM V PRZ T DHD V VK V LHL VK I NOGO NZKIB OBJET BKINI EIS	2 57000
	EMAYN'BKB DIFBC RDIS ADIS THICK, THICO, STANG, TRACO, SOLD , BBM#.	
·	RADUS(95) *THETA.RADTH.ALPHA.RAD.DELTA.GAMMA.ARO.RAR.RLOC.CVAN.	
		. 11000
	COMMON B4.RL.REX.RBASE.BEIA.BEL4. ZD.DINLT.DISTH.TIN.TOUT.XL.VS.	
	COMMON FLAG.VIS.FLACO.WWR.U2.PSIBL.DPIPS.PSIIP.PSILN.FRD	00000
	COMMON XKPHI, PHIRI, PHIRI, PHIRI, CMI, UTI, PHILI, S. XNS, PSIO, PHIR, NCASE	60000
	CORMON WA:XN:RHO:OKI:HUDEH:HIOI:PHIM:VHKW:ETAHI:PSITH:ESHR:RWR	80000
•	COMMON DITTEPS.DS.BS.BBT1.882.Z.Z0.Z1.Z2.Z3.Z4.KK.KSMID.XSI.DPIMP	
	LO.CHS.DH3.DH4.DH3.DH1MP.DH101.BB2.RB3.RB4.SM.QI.SIS.DB.CMS.SCL	90000
	CCTMB: THIMB: CLTOT: THTOT: BLKS: AS SOLI: SOLS: SOL3: SOL4: SOL5: SOL1: SOL	
	. PBC1. BBC2. BBC3. CLC1. CLC2. CLC3. CLT5. THC1. THC2. THC3. THT5. CLR5. THRS.	
	CONMON DHI'S MI'H'BY'BC'SBMI'CLIND. THIND. ZL'DHIND. BLKI'AI' AI'DPIND	50003
	COWNOR DAY ON Y XX (8) XXX (8) XX (8) XXX (8) XX (8) XXX (8) XX (8) X	0000
		70000
	SUBROUTINE DBLPR	tonac
h 72 4 - M		
to the desired		
in the feedby of	96029 4270	מובינישמיםם בדב ש

COT+T+OSLESSES HTTEN

DATE 28 APP 72 PAGE 10

	DATE 28 APR 72 PAGE 11
000057	REV_D=.005185*B4*C34*RHO/VIS
000057	1F (3EVLD-1.5E+05) 15,15,16
000058 000059	AM MENT NO AND
0000059	15 FRV.D=:0032+:221/REVLD**0:23/
000061	16 FRV.D = 1./(0.86858*ALOG(B4/XKFVD) + 1.74)**2
000062	18 OMVLD::FRVLD*(C34/V4)**2/(2.*54)
000062	ONTOE WEDHOMDHOMID
000064	1F(FLAHS-7-) 45,45,46
000065	45 OMTOA=FLA*OMTO
000066	OMIDITEDATONIDA+OMVLD
-000067	60 70 47
000057	46 OMIOT = OMTD + OMVLD
000069	47 ALPH4=ALPH4*57*296
-000070	8F14=BF14*57•296
000071	8FL5=8FL5*57.296
000071	BISM#::DBM#:57.296
000072	IF(PRINT) 50,50,40
000074	40 WRITE (3,507)
000075	WRITE (3, 508) VTH, OMVLD
000075	WRITE (3,509)RVD, OMED / *
000077	WRITE(3,510)V5.0MDD
000078	WRITE(3,511)ADIS,OMID
000079	WRITE(3,512)RED,OMTD
000000	IF(FLAHG-7.) 42,42,41
000081	41 WRITE(3,613) FRO,0MTOT
-000082	60 TO 43
000083	42 WRITE (3,513) FRD, OMTDA
000084	WRITE(3,515) DVD,OMFOT
000085	43 CONTINUE
000086	507 FORMAT(/45x, PERFORMANCE-CHANNEL FLOW APPROACH*//)
000037	508 FORMAT (10X, THROAT VELOCITY: 15X, F10.2, FT/SEC', 7X, FRICTION LOSS
000088	1 COEFF, VANELESS SECTION', F10.4/)
000089	509 FORMAT(10X, THROAT TO INLET VEL. RATIO*, 4X, F10.4, 14X, FRICTION LOS
000000	1S COEFFICIENT, BLADE',5X,F10.4/)
000091	510 FORMAT (10X, DIFFUSER DISCH. VELOCITY: 6X, F10.1, FT/SEC: 7X.
000092	1 'DIFFUSION LOSS COEFFICIENT',11X,F10.4/)
000093	511 FORMAT(10X, DIFF.DISCH. MEAN_CHANNEL ANGLE', F10.3, DEG', 10X,
000094	1 INCIDENCE LOSS COEFFICIENT 1111 (F10.4/)
000095	-512 FORMAT(10X, *REYNOLDS NUMBER, THROAT*, 7X, E11.4, 14X,
000095	1 'TOTAL LOSS COEFFICIENT, BLADE' 8X, F10.4/)
000097	513 FORMAT(10X, FRICTION FACTOR, 15X, F10, 5, 14),
000098	1 *ADJUSTED OVERALL LOSS COEFF.* BLADE*,2X,F10.4/)
00009 9	515 FORMAT(10X, DIFFUSION PARAMETER 11X, F10.4, 14X, TOTAL LOSS COEFFIC
000100	11ENT * .15X . F10 . 4//)
000101	613 FORMAT(10X, FRICTION FACTOR, 15X, F10.5, 14X,
000102	1.TOTAL LOSS COEFFICIENT:.15X.F10.4//)
000103	50 RETURN
000104	END

The second secon

all the second second

i.

.

- 1

*0=5444 I£

begA=0.

IE (ECAG-2.) 61.31.32

900000

990000

#50000

250000

000005 IE (EFV0-5*) 01*52*52 150000 XPDF=11 • 61E-09*XKDF*RHO*XN**3 St Elib=.03*DS 090000 SS XKDE=21.5E-08/RE2 **0.164 610000 8170000 60 TO 24 T**S-T*20ST082E-00*(VF02(BES))**2 ' Z#10000 SI XKDE=3.68431E-06-7.869741E-07*ALOG(RE2)+5.706801E-08*(ALOG(RE2)) 950000 IE (BES-10 ***) SI . SS . SS St0000 885=,3*R2 440000 SO BEX=BS+DB 240000 85 OT 00 00000 •0=S∃∃d £ 100000 IE(EFV@-I*) 2*50*50 010000 XKDE=0. 660000 •0=S83d 950000 PFBV=OMIP*TQBV/550. 000037 920000 IEND) **5 1087=,1562E=07*RH0*40,*(RBV2)**4=(RBV1)**44)*SBV*(OMIP=OMFL)**2*(T 950000 OWEL=OMIP*ROMBV 450000 ROMBV=XBV(1,+XBV) **E**£00000 XBA=LEWb*(#0°\(T*+2°*28A\BBAS)**BES ***S*20*(2BA\BBAS))***2 S60000 TEMP=SBV.8/SCL-1. 120000 NX*340I.=9IMO 000000 000003 ZBA=ZCFV:IJ+ZCF 81_28A=2CF/*T1+2CF 0000038 80 2CF::0.010201+0.0008095*D2+0.00011078*D2**2 720000 IE(2CF) 80+80+8T 920000 920000 BBAT=KS\S* 10 RBV2=R2+DR 0000054 IE(EFYe=7.) IO:10:SO 0:000S2 _000055. KES=US*R2*RHO/(386.*VIS) R2=02/2. 000057 000000 MIWS=MS*(I*+OKI) COWWON CITALLING BETO BERW DO BERBOLLHRY SRV RDSV TEXS IDLDM BCMS 610000 810000 COMMON REFETARIZDISBETAISTO PSHSGIETAOVILOOPIFLAHGISS COVINON BEHG! 221HG! E21HG! XK2E2, XKMSC! DG: D7.C7. DPSSC! DPSKC! C34 **ZT0000** XKDAD'XKTAD'XKEAD'EAD'EFFY' 916000 COMMON BIOB1'818W'818F'818H'DEF'818F2'DEG'811H'OWBB'OWEM'OWON ST0000 2BBW2'FEE'ACROS'AEW'ABS1'DH'AR'ATHI 'RI'NOGO'NSKIP'OPTEI PRINT'FIZ t/TOGOO 000013 SPAAVA4BKE+DIEBC+BDIZ+DIZ+1HICK+1HICO+Z1VHC+1BVCO+Z0FID+BBWH+ 1RADUS (95), THETA, RADIH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN, 0000015 COMMON B4.8L.ZZZ.84.BETA.BFL4.ZD.DIMLT.DISTH.TIN.TOUT.XL.VS. TTOCHO COMMON ELAG.VIS.FLACO.WWR.U2.PSIBL.DPIPS.FSIIP.PSIIN.FRD 010000 600000 COWWON XKBHT BHIST BHISS BHISS CWITCHIT BENEAR BEICT BHIS OCVEE COMMON ME'XN'EHO'OKI'HNDZH'HIOI'DHIMM'NHKW'EIVHI'DZIIH'EZHB'EMB 8000006 COMMON DITYESSIDS'8811'885'5'50'ST'SS'53'ST'NS'KBWID'XZI'DDIWD 400000 210'0H5'0H4'0H2'0H1'0H1'NB'0H10I'8B5'8BQ'8B6'8W'0I'8I'9'0B'CNS'8CF 900000 500000 SCFIMB: LHIMS: CF101: LH101: BFKS: VS: 20F1: 20F5: 20F2: 20F#: 20F2: 20FIB: 20F 100000 T'BBCT'BBCS'BBC2'CCCT'CCCS'CCC2'CCT2'LHCT'LHCS'LHC2'LHL2'CCES'LHG2' COMMON DHIERALAGARA, BRAI, CLIND, THIND, ZL, DHIND, BLXI, ARIABED DPIND 6000003 200000 COWWON XK(8) XX(8) XEE(8) XE(8) SUBBOUTINE DERBY T00000 0 EF1 DEBBA:1:110#51: 02088

\$2 ben2=XbDb*(BEX**#* (5°*xEEX+2°*E1Ib)-5°*x(BB2**2-KEX**2+K5***2))

DVIE S8 VER AS BVEE

	BRUSER, 528 250, 1, 100 DATE 28 APR 72 PAGE 13	
000057	60 To 35	•
000058	61 PFB5=0•	
000059	32 RWR=.55*DT1	
000060	RT1=DT1/2.	
000061	ESHR=5.*ETIP	
000062	PFFS1=XPDF*(RWR**4*(2.*RWR+5.*ESHR)=2.*RT1**5)	
000063	THE SEASON OF THE PARTY OF	
000064 000065	PFFS=PFFS1+PFFS2 35 PFTOT::PF8V+PFFS+PFBS	
000065	DLPUF=17680.*PFTOT/(U2**2*WIMP)	
-000067	PSITE PSITH-PSIBL	
000068	PSINHFSITH+DLPDF	
000069	PSIPSIPS.195*(PH12**2+PS1TH**2)	
000070	DPIPS=PSIPS*U2**2/32.174*RH0/144.	
000071 .	IF(PRINT) 50+50+40	
000072	40 WRITE(3,12) RE2	
000073	WRITE(3,13) XKDF	
000074	WRITE(3.14) PFBV	
000075	WRITE(3,15) PFBS	
000076	WRITE(3,16) PFFS	
000077	WRITE(3,17) PFTOT	
000078	WRITE(3,18) DLPDF	
00007 9 00008 9	WRITE(3,11) PSIIP WRITE(3,43) PSIIN	
000081	WRITE(3,41) PSIPS	
000003	WRITE(3,53) DPIPS	
000083	12 FORMAT (5X, 'REYNOLDS NO., IMPELLER, RE2',11X,E10.4,2X, '****')	
000084	13 FORMAT(SX, DISK FRICTION COEFF., XKDF', 12X, E10.4, 2X, *****)	
000035	14 FORMAT(5X, POWER, BACKVANES, PFBV: 16X, F10.3, 2X, PP!)	
000086	15 FORMAT(5X, POWER, BACK FACE, PFBS', 16X, F10, 3, 2X, PHP')	
000087	16 FORMAT(5X, POWER, FRONT FACE, PFFS', 15X, F10.3, 2X, HP')	
	17 FORMAT(SX, POWER, TOTAL, PFTOT', 19X, F10, 3, 2X, 'HP')	
000089	18 FORMAT(5X,*LOSS COEFF., DLPDF*,20X,F10.4,2X,*****/)	
000090	11 FORMAT(5X, IMPELLER HEAD COEFFICIENT, PSI P1,22X,F10,442X,*****)	
000091	43 FORMAT(SX, INPUT HEAD COEFFICIENT, PSIIN, 25X, F10.4, 2X, ****)	
000092 000093	41 FORMAT(5X**IMPELLER STATIC HEAD COEFFICIENT* PSIPS**15X*F10*4*2X** 1****)	
000094	53 FORMAT(5X, IMPELLER STATIC PRESSURE RISE, DPIPS', 18X, F10, 4, 2X, 'LR/,	
000095	150(N*)	
000096	50 RETURN	
000097	END	
* *		

DATE 28 APR 72 PAGE 14 1.10 helic, 4 25 150, 1, 100 @ ELT GEOM, 1, 710427, 63101 10 mages 2 1 m SUPROUTINE GEOM (IMESSIN) 000001 XK(8) . XZ(8) . XFR(8) . XR(8) 000002 COMMON 000003 COMMON DH1 *RM1 *H *RA *RC *BBM1 *CLIND *THIND *ZL *DHIND *BLK1 *A1 *AB1 *DPIND 1, aBC1.BBC2.BBC3.CLC1.CLC2.CLC3.CLT5.THC1.THC2.THC3.THT5.CLRS.THRS. 000004 2CLIMP.THIMP.CLTOT.THTOT.BLK2.A2.SCL1.SOL2.SOL3.SOL4.SOL5.SOLIP.SOL 000005 3TO: DH2: DH3: DH4: DH5: DHIMP: DHTOT: RP2: RP3: RP4: SM: QI: SIG: DR: CM2: SCL 000006 000007 COMMON DTIFEPS, XX, B2, B3T1, BB2, Z, Z0, Z1, Z2, Z3, Z4, NZ, KBMID, XSI, DPIMP COMMON WP.XN.XXX.OKI.HNPSH.HTOT.PHIMN.VHKM.ETAHI.PSITH.ESHR.RWR 000008 000009 COMMON XKPH1, PHI21, PHI22, PHI23, CM1, UT1, PHI1T, S, XNS, PSI0, PHI2, NCASE โบบอบ10 COMMON FLAG, VIS, FLACO, WWR, UZ, PSIBL, OPTPS, PSIIP, PSIIN, FRD COMMON B4+RL+REX+PBASE+BETA+BFL4+VNS+DINLT+DISTH+TIN+TOUT+XL+V5+ 000011 1 RADUS (95) , THETA , RADTH , ALPHA , RAD , DELTA , GAMMA , ARO , RAR , RLOC , CVAN , 000012 000013 2 ANVANIBER DIFBC, RDIS, ADIS, THICK, THICO, STANG, TRACO, SOLID, BBM4, 3RBM5, FEE, ACROS, AEW, ABS1, DH, AR, ATHRC, PI, NOGO, NSKIP, OPTFI, PRINT, FI2 000014 COMMON RIOPT, RIBM, RIBL, RIBH, DEL, BFL5, DEG, RMTH, OMPR, OMEW, OMOV 000015 000016 COMMON VAIME XKDVD, XK1VD, XKFVD, EVD, FLA, XKQD, Q, QD, QMTQT COMMON RPHG, SSTHG, FSTHG, XKSFS, XKMSC, D6, D7, C7, DPSSC, DPSFS, DPSMC, C34 000017 000018 COMMON RUBET, RUZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, B9 000019 COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5 000020 ALPHA=360./VNS 000021 DIS=TIN+DINLT/2. [0000022] RP=RBASE+DINLT/2. 000023 THETA=ALPHA/2. K=0 000024 000025 100 K=K+1 ANG1=90.-BETA-ALPHA+THETA 000026 000027 ANG2=ALPHA+BETA-THETA FUCT=EXP(3.14159*THETA*SIN(BETA/57.296)/COS(BETA/57.296)/180.) 000028 FTH=SIN((BETA+90.)/57.296)*RBASE*FUCT-RF*COS(ANG2/57.296)-DIS 000029 FPTH=SIN(BETA/57.296)/COS(BETA/57.296)*SIN((BETA+90.)/57.296)* 000030 1RBASE/57.296*FUCT-RP*SIN(ANG2/57.296)/57.296 000031 000032 ERROR=FTH/FPTH THETA=THETA-ERROR 000033 IF (ABS (ERROR) -0.01) 140,140,150 000034 000035 150 IF (K-30) 100,300,300 000036 140 C=DIS/COS(ANG2/57.296) 000037 RAD=RP+C 000038 DELTA=57.296*ATAN((TOUT-TIN)/XL) GAMMA=ALPHA+THETA+BETA-DELTA 000039 000040 ANG3=0. N≡O 000041 200 N=N+5 000042 ANG3=ANG3+5. 000043 000044 IF (ANG3-THETA) 210,220,220 210 RADUS(N)=RBASE*EXP(3.14159*ANG3*SIN(BETA/57.296)/COS(BETA/57.296 000045 1)/180.) 000046 000047 220 RADTH=RBASE*EXP(3.14159*THETA*SIN(BETA/57.296)/COS(BETA/57.296)/ 000048 000049 1180.) CD=XL-DIS*SIN(ANG2/57.296)/COS(ANG2/57.296) 000050 000051 AXG2=90.+ANG2 OD=SGRT (RAD**2+CD**2-2.*RAD*CD*COS(AXG2/37.296)) 000052 000053 PHI=ASIN((CD/OD)*SIN(AXG2/57.296))*57.296

000054

000055

000056

BKA=PHI+ALPHA

ZETA=ATAN(DE/CD)*57.296

DE=DISTH/2.0

	DATE 28 APR 72 PAGE 15	
000057	CE=CD/COS(ZETA/57.296)	
000058	VE=ZETA+AXG2	
000059	OETSGRT (RAD**2+CE**2-2•*RAD*CE*COS(VE/57•296))	
000060	DIFBC#0E4DE	
000061	ОМЕ-9A::ASIN((CE/OE)*SIN(VE/57.296))*57.296	
000062	BK3::oMEGA+ALPHA	
000063	XLX::\\/COS(THETA/57,296)	
000054	SG= (L. *COS(GAMMA/57.295)-(DINLT/2.0)*SIN(ANG2/57.295)	
000055	P0=XLX*S1N(GAMMA/57.296)	
000066	RG=DIFBC*SIN(BKB/57.295)	
000067	0R=D±=8C*COS(BKB/57.€296)	
000068	PT::(R:3ASS+()INLT/2.)+()INLT*COS(ANG2/57.296)/2.0)+P0)+OR	
000069	6THRG-5Q	
000070	GP=50RT(PT**2+GT**2)	
000071	PH=9P/2 · 0	
000071	SI=ATIN(SQRT(1.0/(PT/GP)**2-1.0))*57.296	
000073	TI=SI-GAIMA	
000074	R43=PH/COS(TI/57.256)	
000074	RAY=0R+PT-RAR*COS(GAMMA/57.296)	
000076	RAX=SU+RAR*SIN(GAMMA/57.296)	
000070	ARO=ATAN(RAX/RAY)*57.296	
000078	PLOC=SQRT (RAY**2+RAX**2)	
000079	FANG=ABS (ARO-360./VNS)	
	HEIGH=(RBASE**2+RLOC**2-2*RBASE*RLOC*COS(FANG/57.296))**.5	
000080	THICK=RAR-HEIGH-DINLT-IIN	
000081		
000082	IF(RAR+RLOC-DIFEC)70,70,80	
000083	80 IF(BK8-ARO)70.70.71	
000084	71 XLX=XL/COS(DELTA/57.296)	
000065	XAP=COS (GAMMA/57.296) *XLX	
000086	YAP=RBASE+DINLT+XLX#SIN(GAMMA/57.296)	
000087	HOP=6AMMA+ATAN(XAP/YAP)*57-296	
880000	SAP=SQRT (XAP**2+YAP**2)	
000089	FUNX=(DIFBC/SAP-COS(HOP/57-296))/SIN(HOP/57-296)	
000090	PHO=ATAN (1./FUNX) *57.296	
000091	RAR=SIN((1802.*RHO-HOP)/57.296)*SAP/SIN'2.*RHO/57.296)	
000092	ARO=ATAN(XAP/YAP)*57.296+180-(2.*RHO+HOP)	
000093	RLOC=DIFBC-RAR	
000094	FANG=ABS (ARO-360./VNS)	
000095	HEIGH=(RDASE**2+RLOC**2-2*RBASE*RLOC*COS(FANG/57-295))**-5	
000096	THICK=RAR-HEIGH-DINLT-TIN	
000097	70 CVAN=SQRT(RP**2+0E**2-2.0*RP*0E*COS(RKB/57.296))	
000098	x=(0E/CVAN)*SIN(8KB/57.296)	
000099	XLT=TOUT/(SIN(DELTA/57.296)/COS(DELTA/57.296))	
000100	D2=DELTA/2.0	
000101	DHR=XLT*(SIN(D2/57-296)/COS(D2/57-296))	
000102	0Z=0D*ABS(COS(BKA/57•296))	
00103	ANDX=THETA-BETA	
300104	0V=0Z-DHR*COS(ANDX/57-296)	
000105	DV=OD*SIN(BKA/57.296)-DHR*SIN(ANDY/57.296)	
000105	RDIS=SQRT(0V**2+DV**2)	
000107	DISA=ATAN(DV/OV)*57.296	
000108	ADISEDISA+BETA-THETA-UZ	
000129	IF (X-1.0000) 33,31,32	
000110	33 ANVAN=ASIN((OE/CVAN)*SIN(BKB/57.296))*57.296	
000111	60 TO 11	
000112	31 ANVAN=90.0	
000113	60 TO 11	
	32 ANGL=ASIN ((DIS/CVAN)*SIN(BKB/57.296))*57.296	
000114		

	64171CR • 428250 v 1 • 100		DATE 28 APR 72 PAGE	16	
					•
000117	R1=RB/\SE+DINLT/2.				
000118	STANGH90ATAN(ALOG(RO				
000119		STANG)/57.295)+(DISTH+DINLT)/2.		and the second s	
000120	IF(FLλHG-7.) 72.72.74	+(BKB /57.296):/*2)**.5/350.	+VMC+57 206		
000121	72 SOLID: ((ALOG(RO/R1))**2-	*(UND /5/•296)**2/**•5/36U•	**VIVO**3/ € 20	•	
000122	GO TO 75 74 SOLID = 2.*(RL*TIN+DLDM)	//TINATOUT)			
000123	74 SOCIUTE 20*** (GAMMA+BETA)/20				
000124		/57.296)*RADTH/(DIFBC-DISTH))*5	57.296	•	,
000126	IF (BK 3-AFO) 85, 90, 90	STIESOT MICHIEL TOX DO DESTINATE			
000127	85 A05=90ASIN(RLOC*SIN((/	RO-BKB)/57.296)/RAR)			
000128	BUM5=(AOS+AIN)/2.			•	
000129	60 TO 91	:			
000130	90 BBM5=(90.+AIN)/2.				
000131 .	91 FEE=BRM4-BBM5				
000132	THICO=THICK/TRACO				
000133	AW=3.14159*(DIFBC**2-(RE				
000134	ACROS=TRACO*(DISTH+DINL	[+4.*THICK)/6.	·•		•
000135	AEW=2,*(AW-VNS*ACROS)	-0.40 -4.510 T. 5165-14			
000136 ,		59/2.*(DINLT+DISTH)+THICK)			
000137	AR=AEW/VNS/ABS1	(TTN: TOUT) (2.)			
000138	DH=B4*(TIN+TOUT)/4./(B4-	* SIN((90.+ADIS)/57.296)))*57.	296		
000139 000140	BCM5 = 90BDEX	* SINTIBUTANTS//D/*5/01/142/		· /	
000141	THEX = 90 ADIS - BDE	•			
000142)*DIFRC/SIN((90.+ADIS)/57.296)			
000142	TEX5 = (XL+DLDM)/XL*(TO		to a second of the second		
600144	60 TO 301			·	
000145	300 IMESS=1			•	
000146	301 RETURN	•			
000147	END				
					,,
•					

		IE(BEW-1°E+02) 22°22°22 IE(CFIMD) 20°20°27	SS0000
		PEM=DH101*KH0*WMR\(96.522*VIS)	. 60000 ± 50000 ± 50000 ± 500000 ± 500000
		bzinc=0*12*(bhimi*(cos(Bemik)\sin(Bemik)-cos(BBMik)\sin(BBMik)))**	000002
		WWR=0.5*(WBMI+W2TH)	TS0000
		EM = MSLHVM1T	090000
	•	$MLT = 2061(CWT**S + \OmegaLT**S)$	6±0000
		MSIH=2081(CNS**S+MNSIH**S)	. 840000
		WUSTH=U2*(1SLPCF*(1PHI2*COS(BB2R)/SIN(BB2R)))	Ztr0000
•	• •	PHIM1=DT1*PHI1T/OM1	940000
		MEMT=0.321*01/(AB1*SIN(BBM1R))	S40000
		BEMTK=BEWT\2\500 536	hh000 0
		BB11K=BB11/S7•296	0000t3
		BBWTK=BBWT\21*506	00000
		BEMIT=*275*BBMI	T#0000
		CLIOI=CLIMP+CLIMD	0t)0000
			650000
		ALP2 = ATAN(CM2/CU2TH)*57.296	. 820000
		CS = 20K1(CNS1H**S + CWS**S)	
		PSITH=CUSTH/U2	920000
		CNSIH=2FbcE*cnSE	0000022 56
		ZFbCF=11.98/Z	00002t
		eo 10 se	££0000
		<pre>ZFbCE=I*\(I*+bZF)</pre>	00000S
		b2r=b2i2f*#5\z\z\	
		PSISL=.6*(1.+8B2/60.)	67 090000
		IE(BBS	000059
		COSE=OS-CHSN2IM(BBSK)*COZ(BBSK)	620000
	1 .	882/57,296	000027
. •		DEFK=S8.0/CCL	970000
		_CCC==CrWb\s^6	000052
		RT1=0T1/2.	90002th
		ყჳ= ი ნ∖ნ∙	800052
		DW1=2.*RM1	000055
		EQUIANLENCE (PSITH, PSIT), (PHIS, PHI), (US, U)	120000
		COWWON CEN1:EINC:BETO:BBW:D0:BBP3:LHBA:SBA:BD2:LEXE :DFDW:BCW2	000050
	i.	COMMON RLBET, RLZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, 89	6T0000
		COMMON BEHC. SZIHC. EZTHC. XXSES. XKMSC. DC. D7. CZ. DPSSC. DPSFS. DPSMC. C34	870000
		COMMON AGENE XKDADEXKIADEXKEADEEADEEAE XKODEGOOOOMLOI	ZT0000 -
		COWWOR BIOSI'BIRW'BIRF'BIRF'BET'BETR'DEO'SWIH'OWSB'OWEM'OWOA	
		ABMS, FEE, ACROS, AEW, ABSI, DH, AR, ATHI, BI, NOGO, NSKIP, QOTEI, PRINT, EIZ	
		SVAAVAGERBES DIEBC BDIS BDIS BHICK BHICO BIBAG BLANG BROO BOFID BBW B	
		RADUS (95) THETA, RADTH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN.	t£10000
		CONWON BUTSET SEET Y BELY BELT Y DO DINTINDIZHTIN LONIXT AZ	000075
		COMMON EFFCAIS'EFVCO: MMB'OS'ESIBF'DELES'SZIIB'ESIIM'EBD	• • • • • • • • • • • • • • • • • • • •
		COMMO/LXKPH1,PHI21,PHI22,PHI23,CM1,UT1,PHI11,5,XNS,PSIO,PHI2,NCASE	010000
	, <u>, , , , , , , , , , , , , , , , , , </u>	COWWO! ME'XW'BHO'OKI'HNDZH'HLOL'BHIWN'NHKW'ELVHI'BZILH'EZHB'BMB	. 600000
		COWWOW DIT*ED2*D5*B5*BB1*BB5*5*S0*S7*S5*S2*S7*X3WID*X21*D6IWb	800000
	•	240.bH2.bH4.bH4.bH5.6H1MP.bH10T.bR2.RR3.RP4.sM.oI.s1c.pR.cM2.sCL	
		SCLIMP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL3, SOL4, SOL5, SOLIP, SOL	2 000000
		**BECI*BBCS*BBC3*CFCI*CFCS*CFC3*CFL2*IHCI*IHCS*IHC3*IHL3*CFU3*IHB2*	Ç \$0000ü
		COMMON DHI BUTTH BY BY BE BRITCHIND THIND TO DHIND BERT VITVET DEIND	
		CONMOIA XK(8) *XX(8) *XK(B) *XK(B)	£00000
	•	BEVE KOWID	00000
		SORIUME IFOSS	100000
	The Contradition of the Co		
•	च १ रक्ताकृतः 	A Para Commence of the Commenc	
		0457 55104	© ECT 10025-11-710

DATE 28 APR 72 PASE 17

. **ดอร์สุรสักร**สุธรษาสาเมลุทิต

..

_		€0 10 3 S FI=0•	911600 911000
* ·		1 FI=1(Y25*Y**2)**2	#TT000
		IE(A-S*)7.5.5	000113
		Y=DELR*DT/(2.*DSTR)	000775
		DSTR=1.72*SORT(VI*CLPT*COS(A)*DELK/(PHI*U))	111000
	•	A=1.5708-B92R	000110
•	* · · · · · · · · · · · · · · · · · · ·	V1=32.174*V1S/RHO	661000
		CLPT=CLIMP/IZ.	807000
		01=D2\1 2.	201000
	,	80R=82 \0 2	901000
		DET8=2CF\DS	901000
		#20 CONTINUE	701000
		00 10 01 09	000702
		•0=70\$	000105
•		. DErк=0•	101000
•		DELE=0.	001000
·		#51 PSCL=0	660000
•	•	HSO FORMAT(/SX**IMPELLER IS SHROUDED**/)	860000
	. •	#30 MBILE(3) #50)	460000
		440 IF(PRINT) 421-421-439	960000
•		ππυ 1Ε(ΒΒΙΝΙ) ποι•ποι» που συστασταστασταστασταστασταστασταστασταστασ	960000 S60000
	· · · ·		#60000
		#20_2CC=0*010501+0*00080002*DS+0*000110\9*US**5 #10_IE(2CC) #20*##0+20	260000
•	:	######################################	000092
		IΕ(ΕΓΥΘ-17-) π10-π10 μ00 μπ0 μπ0 μπ0 μπ0 μπ0 μπ0 μπ0 μπ0 μπ	T60000
			060000
		HIH=b2IIH*NS**S\3S*IIh b2I8F=b2INC*b2E+b2D+b2IIb	680000
			660003
		\$**dWId0*00*05d=05d	780000
*, · · · ·		## ### ###############################	980000
		### DETIBHER* (BMIS*8) KS/**5 b2010=0*02*Db1ND**0*5	580000
		b2E=b2F1b+b2EID	<u> </u>
		PSFID=32.174*HLFID/U2**2	\$60000
		CLFID=64.348*HLFID/WMR**2	S80000
			180000
		#3 HFEID=EKIND*CFIND*MIND**S\(52\)*26s*OHIND).	186900
	· · · · · · · · ·	#5 EBIND = 1*\(0*86858*PFD@(DHIND\(S**XKW3C))+1*\#)**\$ 60 10 #2	620000
	t,	#1 FRIND=0.0032+0.221/REIND**0.237	870000
<i>f</i>	and the second of the second o		ZZ0000 ZZ0000
\dot{l}		IE(WEIND - T'E+02) #1'#1'#5 WEIND::DHIND::BHO*NIND\(60*2SS*AIZ)	, 976200
		MIAD#MBW[#2IN(BBWIB)\ZIN(BGWIB#(I*+KBWID)*0*2)	920000 920000
•	- · ·	PSF1P::32.174.HLF1P/U2**2	470000
•			#20000 \$20000
		C[F1b=04*3+8*HiFE1b\MW8**Z	270000 E70000
		20 H/EIbmM/Lb**S\@#.22*(E3IMb*CFIWb*0.5S\DHIMb)	. 170000
		98 FRIMP = 1./(0.86858*ALOG(DHIMP/(2.*XKMSC))+1.74)**2	. 12,0000
			650000
		37 FR. VP=0. 5032+0.221/REIVP**0.237	890000
		It (3E 1Mb-1*E+02) 21.21.28	750000
		BEIMD DHIMD*BHO*MWID\(60°255*AIZ)	990000
		27 MWISHD*E*(MBWT*ZIN(BBWTB)\ZIN(KBWID*BBWTB)+MS1H)	990000 . 990000
		0t7 O.L 09	590000 590000
	A STATE OF THE STA	<u>• 0</u> ≡0105d	290000
		EMIND = ERM	290000 290000
•		PSELW/W(**\$\(\$**U**2)*CLF	190000
		HT: 17484*5\0404*2000	
m // feether		26 CLF=FRAM*CLTOT/(4,*DHTOT)	090000 690000
**		35 FRM = 1./(0.86858*ALOG(DHTOT/(2.*XKMSC))+1.74)**2	
		9ç '01 '09	850000
•		33 FIN=0.0032+0.221/REM**0.237	720000
	OVIE SH VEG A: EVEE TH	001-1405-150-000-00-0	
	DVIE SE VSG AN BYCE IE		

	Birth CR + 428 (50 - 1 + 100)		1	DATE 28 APR 70	1 PAGE 19	
000117	3 G=PHI"PSIT/(SIG*COS(A))					
000118	DE'_E=DELR*G**.5*(1.+(COS	_	•5/(BDR*COS(A))			
000119	PSCL=32.174*DELE*HTH/U2** PSIBL=PSIBL+PSCL	*2				عابر ومعيودها
000120	470 CONTINUE					
000121 000122	IF (PR (NT) 50,50,60	,	•			
000123	60 WRITE (3,12) SCL. PSINC + CU2	2TH				
000124	WRITE(3,14) DELE PSF, C2					
000125	WRITE (3,16) DELK . PSD . ALP	2				
000126	WRITE(3,18) DELR.PSTIP.FF	RIMP			<u> </u>	
000127	WRITE (3,20) W2TH PSCL					
000128	WRITE(3,22) RW+PSIBL	•				
000129	WRITE(3,10) SLPCF,PSITH		<u></u>			
000130	WRITE(3,24) HTH . 10 FORMAT(5X,7HSLPCF =,3X,F:	10 4 048 7405774	#. #V. E10 # //			
000131 000132	12 FORMAT (/5X+7HSCL =+3X+F					
000133	124X, 7HCU2TH =, 3X, F10.3)	1045724771111 52111	<u> </u>			
000134	14 FORMAT(5X,7HDELE =,3X,F)	10.3.24X.7HPSF	=,3X,F10.4,			•
000135	124X,7HC2 =,3X,F10.3)					
000136	16 FORMAT (5X, 7HDELK = .3X, F.	10.3,24X,7HPSD	=,3X,F10.4,			f
000137	$124X \cdot 7HALP2 = \cdot 3X \cdot F10 \cdot 3$					f = f
000138	18 FORMAT (SX.7HDELR =.3X.F)	10.3.24X,7HPSTIP	=,3X,F10.4,			
000139	124X,7HFRIMP =,3X,F10,3)	40 3 00V TUDECI	m. 7V. E10 //\		•	
000140 000141	20 FORMAT(5X+7HW2TH =+3X+F) 22 FORMAT(5X+7HPW =+3X+F)	10.3,24X,7HPSCC				
000141	24 FORMAT (5X, VHHTH =, 3X, F					
000143	50 RETURN	10107				
000144	END				•	
				,		
		•				
and the second s						1
						* * * * * * * * * * * * * * * * * * * *
					· · · · · · · · · · · · · · · · · · ·	

Ġ.	FLT	IMGEO	. 1 .	710427	. 5310	9

000001	
000001	SUBROUTINE IMGEO
000002	REAL KOMID:KP1:KP2:KP3:KP4
000003	COMMON XK(8) *XZ(8) *XR(8) *XR(8)
000004	COMMON DHIRMI, H.RA.RC. BBMI, CLIND, THIND, ZL. DHIND, BLKI, AI, ABI, DPIND
900005	1.BBC1.BBC2.BBC3.CLC1.CLC2.CLC3.CLTS.THC1.THC2.THC3.THTS.CLRS.THRS.
000006	20LIMP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL4, SOL4, SOL5, SOL1P, SOL
(00007	3TO,DH2,DH3,DH4,DH5,DHIMP,DHTOT,RP2,RP3,RP4,SM.01,SIG,DR,CM2,SCL
000008	COMMON DI1/EPS,D2/B2/BBI1/BB2,Z2/Z0/Z1/Z2/Z3/Z4/NZ/K3MID/XSI/DPIMP
000009	COMMON WP, XN, RHO, OKI, HNPSH, HTOT, PHIMN, VHKM, EIAHI, PSITH, ESHR, RWR
000010	CCMMON XKPH1,PHI21,PHI22,PHI23,CM1,UT1,PHI1T,S,XNS,PSIO,PHI2,NCASE
000011 .	COMMON FLAG, VIS, FLACO, WWR, U2, PSIRL, DPIPS, PSIIP, PSIIN, FRD
000012	COMMON 84-RL, REX-R4-BETA-BFL4-ZD-DINLT-DISTH-TIN-TOUT-XL-V5-
000013	IRADUS (95) * THETA RADTH, ALPHA RAD, DELTA, GAMMA ARO, RAR, RLOC, CVAN,
000014	2ANVAN+BKH+DIFBC+RDIS+ADIS+THICK+THICO+STANS+TRACO+SOLID+BBM4+
000015	38BM5, FEE, ACROS, AEW, ABS1, DH, AR, ATHT , RI, NOGD, NSKIP, OPTFI, PRINT, FIZ
000016	COMMON RIOPT, RIBM, RIBH, DEL, RELS, DEQ, RITH, OMPR, OMEW, OMOV
000017	COMMON V4+M+ XKDVD,XKIVD,XKFVD,EV),FLA+ XKOD,O+OD+OMTOT
000017	COMMON RPHG.SSTHG.FSTH3.XKSFS.XKMSC.D6.D7.C7.DPSSC.DPSFS.DPSMC.C34
000019	COMMON RUBET, RLZD, SETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, B9
	COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5
000020	
000021	DH1=EPS*DT1
000022	DM1=SQRT(0.5*(DT1**2+DH1**2))
000023	RM1=0+5*DM1
000024	H=0.5*(DT1-DH1)
000025	RA=0.75*(H+82)
000026	RC=RM1+RA
000027	XSI=DT1/D2
000028	R2=D2*0•5
000029	IF(R2-RC) 10,10,11
000030	10 RA=R2=RM1
000031	
	RC::R2
	RC::R2
000032	IF(PRINT) 11,11,13
000032 000033	IF(PRINT) 11,11,13 13 WRITE(3,500)
000032 000033 000034	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5x, RC2 EQUALS R2, /)
000032 000033 000034 900035	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5x, RC2 EQUALS R2, /) 11 RC2=0.134*RA+RM1
000032 000033 000034 000035 000036	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2
000032 000033 000034 900035 900036 000037	IF(PRINT) 11,11,13 13 wRITE(3,500) 500 FORMAT(5X,FRC2 EQUALS R2'/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 BBT1R=BBT1/57.296
000032 000033 000034 900035 000036 000037	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X, RCZ EQUALS R2'/) 11 RCZ=0.134*RA+RM1
000032 000033 000034 000035 000036 000037 000038 000039	IF(PRINT) 11:11:13 13 WRITE(3:500) 500 FORMAT(5X:*RC2 EQUALS R2:/) 11 RC2=0:134*RA+RM1 PC3=0:366*RA+RC2 BBTIR=BBT1/57:296 BBM1=ATAN(OT1/DM1*SIN(BBT1R)/COS(BBT1R))*57:296 BBM1R=B8M1/57:296
000032 000033 000034 900035 000036 000037	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X, RCZ EQUALS R2'/) 11 RCZ=0.134*RA+RM1
000032 000033 000034 000035 000036 000037 000038 000039	IF(PRINT) 11:11:13 13 WRITE(3:500) 500 FORMAT(5X:*RC2 EQUALS R2:/) 11 RC2=0:134*RA+RM1 PC3=0:366*RA+RC2 BBTIR=BBT1/57:296 BBM1=ATAN(OT1/DM1*SIN(BBT1R)/COS(BBT1R))*57:296 BBM1R=B8M1/57:296
000032 000033 000034 900035 000036 000037 000038 000039	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1
000032 000033 000034 900035 900036 000037 000038 900039 000040	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1
000032 000034 000034 000035 000036 000037 000038 000039 000040 000041	IF(PRINT) 11,11,13 13 wRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.365*RA+RC2 8BT1R=BBT1/57.296 BBM1=ATAN(DT1/DM1*SIN(BBT1R)/COS(BBT1R))*57.296 BBM1R=B8M1/57.296 TEMP=B82/BBM1/K8MID CK1=TEMP**1.05-TEMP+1. TEMP=882/(KBMID*RBM1)
000032 000034 000035 000035 000037 000038 000039 000040 000041 000042	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 BBT1R=BBT1/57.296 BBM1=ATAN(DT1/DM1*SIN(3BT1R)/COS(BBT1R))*57.296 BBM1E=BBM1/57.296 TEMP=BB2/BBM1/KBMID CK1=TEMP**1.05-TEMP+1. TEMP=B82/(KBMID*RBM1) CK2=1.+(TEMP**1.05-TEMP)/6.
000032 000034 000034 000035 000036 000037 000038 000039 000040 000041 000042 000043	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,*RC2 EGUALS 92*/) 11 RC2=0.134*RA+RM1
000032 000034 000034 000035 000035 000037 000038 000039 000041 000042 000043 000044 000044	IF(PRINT) 11,11,13 13 WRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 BBT1R=B8T1/57.296 BBM1=ATAN(OT1/DM1*SIN(BBT1R)/COS(BBT1R))*57.296 BBM1=B8M1/57.296 TEMP=B82/BBM1/KBMID CK1=TEMP**1.05-TEMP+1. TEMP=B82/(KBMID*RBM1) CK2=1.+(TEMP**1.05-TEMP)/6. CK3=1.+(TEMP**1.05-TEMP)/10. TEMP=KBMID*BBMID*BBMI TMP2=B82-TEMP*
000032 000034 000034 000035 000035 000037 000038 000039 000041 000042 000043 000044 000045	IF(PRINT) 11,11,13 13 wRITE(3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 8BT1R=B8T1/57.296 BBM1=ATAN(DT1/DM1*SIN(3BT1R)/COS(BBT1R))*57.296 BBM1R=B8M1/57.296 TEMP=B82/8BM1/K8MID CK1=TEMP**1.05-TEMP+1. TEMP=882/(KBMID*RBM1) CK2=1.+(TEMP**1.05-TEMP)/6. CK3=1.+(TEMP**1.05-TEMP)/10. TEMP=KBMID*BBM1 TMP2=B82-TEMP BBC1=TEMP+CK1/6.*TMP2
000032 000034 900034 900035 900035 900037 900039 900041 900042 900042 900044 900044 900046 900046	IF(PRINT) 11:11:13 13 WRITE(3:500) 500 FORMAT(5X:*RC2 EQUALS R2*/) 11 RC2=0:134*RA+RM1 RC3=0.366*RA+RC2 BBT1R=BBT1/57:296 BBM1R=BBM1/57:296 TEMP=BB2/BBM1/KBMID CK1=TEMP**1:05-TEMP+1* TEMP=BB2/(KBMID*BBM1) CK2=1:+(TEMP**1:05-TEMP)/6* CK3=1:+(TEMP**1:05-TEMP)/10* TEMP=KBMID*BBM1 TMP2=BB2-TEMP BBC1=TEMP*KK1/6:*TMP2 BBC2=TEMP+CK2/2:*TMP2
000032 000034 000034 000035 000036 000037 000039 000040 000041 000042 000043 000044 000045 000046 000047	IF (PRINT) 11:11:13 13 WRITE (3:500) 500 FORMAT(5X:*RC2 E0UALS 92'/) 11 RC2=0:134*RA+RM1 RC3=0:366*RA+RC2 8BT1R=BBT1/57:296 8BM1=ATAN(0T1/DM1*SIN(3BT1R)/COS(8BT1R))*57:296 8BM1=8801/57:296 TEMP=882/RBM1/KBMTD CK1=TEMP**1:05-TEMP*1: TEMP=882/KBM1D*BBM1) CK2=1:+(TEMP**1:05-TEMP)/6: CK3=1:+(TEMP**1:05-TEMP)/10: TEMP=KBM1O*BBM1 TNP2=B82-TEMP BBC1=TEMP+CK1/6:*TMP2 BBC2=TEMP+CK2/2:*TMP2 BBC3=TEMP+S:*CK3/6:*TMP2
000032 000034 000034 000035 000035 000037 000038 000039 000041 000042 000043 000045 000046 000046 000047 000048	IF(PRINT) 11,11,13 13 WRITE(5,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1
000032 000034 000034 000035 000035 000037 000039 000041 000042 000043 000044 000045 000046 000047 000048	IF (PRINT) 11,11,13 13 WRITE (3,500) 500 FORMAT(5X,*RC2 EQUALS R2*/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 BBTIR=BBT1/57.296 BBM1=ATAN (OT1/OM1*SIN(3BT1R)/COS(BBT1R))*57.296 BBM1=BB2/BBM1/57.296 TEMP=BB2/BBM1/57.296 TEMP=BB2/BBM1/57.296 TEMP=BB2/KBMID CK1=TEMP**1.05-TEMP+1. TEMP=BB2/KBMID* CK2=1.+(TEMP**1.05-TEMP)/6. CK3=1.+(TEMP**1.05-TEMP)/10. TEMP=KBMID*BBM1 TMP2=BB2-TEMP BBC1=TEMP+CK1/6.*TMP2 BBC3=TEMP+CK2/2.*TMP2 BBC3=TEMP+CK2/2.*TMP2 BBC3=TEMP+S-*CK3/6.*TMP2 BBC1=BB2/57.296
000032 000034 000034 000035 000035 000037 000038 000039 000041 000042 000043 000044 000045 000046 000047 000048 000049 000050	If (PRINT) 11,11,13 13 WRITE(5,500) 500 FORMAT(5%'RC2 EQUALS 92'/) 11 RC2=0.134*RA+RM1 RC3=0.366*RA+RC2 BBIIR=BBII/57.296 BBMIR=BBMI/57.296 BBMIR=BBMI/57.296 BBMIR=BBMI/57.296 TEMP=BB2/BBMI/KBMID CK1=TEMP**1.05-TEMP+1. TEMP=BB2/(KBMID*BBMI) CK2=1.+(TEMP**1.05-TEMP)/6. CK3=1.+(TEMP**1.05-TEMP)/10. TEMP=KBMID*BBMI TMP2=BB2-TEMP BBC1=TEMP(KI/6.*TMP2 BBC2=TEMP+CK1/6.*TMP2 BBC3=TEMP+CK2/2.*TMP2 BBC3=TEMP+S.*CK3/6.*TMP2 BBC1=TEMP+S.*CK3/6.*TMP2 BBC1=BBC2/57.296 BBC2R=BBC1/57.296 BBC2R=BBC1/57.296
000032 000033 000034 500035 000037 000038 000039 000041 000042 000042 000045 000046 000046 000047 000048 000049 000051 000052 000053	IF (PRINT) 11.11.13 13 WRITE (3.500) 500 FORMAT(5X.*RC2 EGUALS R2*/) 11 RC2=0.134*RA+RM1
000032 000034 000034 000035 000035 000037 000038 000039 000041 000042 000043 000044 000045 000046 000046 000047 000048 000049 000050 000051 000052	IF (PRINT) 11.11.13 13 WITE (3,500) 500 FORMAT (5X', RC2 EQUALS 92'/) 11 PC2=0.134*RA+RMI PC3=0.366*RA+RC2 BBIR=BBII/57.296 BBM1=ATAN(OT1/DM1*SIN(3BTIR)/COS(BBTIR))*57.296 BBM1=BBM1/57.296 TEMP=182/BBM1/KBMID CK1=TEMP**1.05=TEMP+1. TEMP=182/RBM10*BBM1) CK2=1.+(TEMP**1.05=TEMP)/6. CK3=1.+(TEMP**1.05=TEMP)/10. TEMP=KBM10*BBM1 TMP2=B82-TEMP BBC1=TEMP+CK1/6.*TMP2 BBC2=TEMP+CK2/2.*TMP2 BBC3=TEMP+5.*CK3/6.*TMP2 BBC3=TEMP+5.*CK3/6.*TMP2 BBC3=TEMP5-7.296 BBC3R=BBC2/57.296 BBC3R=BBC2/57.296 BBC3R=BBC2/57.296 CLIND=3.14159/70*PM1*SOL1
000032 000033 000034 500035 000037 000038 000039 000041 000042 000042 000045 000046 000046 000047 000048 000049 000051 000052 000053	IF (PRINT) 11.11.13 13 WRITE (3.500) 500 FORMAT(5X.*RC2 EGUALS R2*/) 11 RC2=0.134*RA+RM1

```
DATE 28 APR 73 PAGE
                   5.00 Ch. C. P. 4.2625,0 + 1 + 100
                        ZL=3.14159/Z0*DM1*SOL1*SIN(CLCB)
000057
                        CLC1= (RC2-RM1)/(0.259*SIN(BBC1R))
000058
000059
                        CLC 2:: (RC3-RC2)/(0.707*SIN(BBC2R))
000060
                        CLC3=(RC-RC3)/(0.965*SIN(BBC3R))
180009
                        CLTS=CLC1+CLC2+CLC3
                        THC1::57,296*(ALOG(RC2)-ALOG(RM1))/(0.259*SIN(BBC1R)/COS(BBC1R))
000062
                        THC2::57.296*(ALOG(RC3)-ALOG(RC2))/(0.707*SIN(BBC2R)/COS(BBC2R))
000063
                        THC3m57.296*(ALOG(RC)-ALOG(RC3))/(0.965*SIN(BBC3R)/COS(BBC3R))
000064
                        THTS=THC1+THC2+THC3
000065
000066
                        CLRS=(R2-RC)/SIN(BB2R)
                        THES::57.296*(ALOG(R2)-ALOG(RC))/(SIN(BB2R)/COS(BB2R))
000067
000068
                        CLIMP#CLTS+CLRS
000069
                        THIMP=THTS+THRS
( J0070
                        CLTOT=CLIMP+CLIND
000071
                        TPTOT=THIMP+THIND
000072
                        IF(20) 20,20,21
000073
                     20 ZX=21
000074
                        GC TO 22
                     21 ZX=Z3
000075
                     22 BLK1=0.025*ZX/(RM1*SIN(BBM1R))
[000076]
000077
                        A1=0.7853975*(DT1**2~DH1**2)
0.00078
                        AB1=A1*(1.-BLK1)
000079
                        TM1=6.28318*RM1/ZX
                        IF(Z0) 23,23,24
000030
180000
                     23 SOL1=0
000082
                        DPIND=0
000083
                        DHIND=0
000084
                        THIND=0
000085
                        CLIND=0
000036
                        GO TO 25
                     24 DHIND=(1.-BLK1)*TM1*SIN(CLCB)*H/(2.*((1.-BLK1)*TM1*SIN(CLCB)+H))
000087
                        DIND=1.-SIN(BBM1R)/SIN(KBMID*BBM1R)+(COS(KBMID*BBM1R)/SIN(KBMID*
850000
000089
                       1BBM1R)-COS(BBM1R)/SIN(BBM1R))*SIN(BBM1R)/(2.*SOL1)
                        DPIND=DIND
000090
000091
                     25 ZX=Z0
                        A2=(1.-BLK2)*3.14159*D2*82
000092
000093
                        RBD=82/D2
000094
                        IF(NZ-2) 30,31,32
000095

    30 RM2=SQRT(0.5*(R2**2+RM1**2))

000096
                        SOLIP=CLIMP*Z/(6.28318*RM2)
                        SOLTO=SOL1+SOLIP
000097
                        PMC1=SQRT(0.5*(RM1**2+RC2**2))
000098
000099
                        RMC2=SQRT(0.5*(RC2**2+RC3**2))
                        RMC3=SORT(0.5*(RC3**2+RC**2))
000100
                        TMC1=6.28318*RMC1/Z*SIN(BBC1R)-0.157
000101
                        TMC2=6.28318*RMC2/Z*SIN(BBC2R)-0.157
000102
                        TMC3=6.28318*RMC3/Z*SIN(BBC3R)-0.157
(00103
                        RMRS=SQRT(0.5*(RC**2+RC2**2))
000104
000105
                        TMRS=6.28318*RMRS/Z*SIN(BB2R)-0.157
000105
                        HMC1=R2*82/RC+(RC-RMC1)*(H-B2*R2/RC)/(RC-RM1)
                        HMC2=R2*B2/RC+(RC-RMC2)*(H-B2*R2/PC)/(RC-PM1)
000107
                        HMC3=R2*B2/RC+(RC-RMC3)*(H-B2*R2/RC)/(RC-RM1)
000108
                        HMRS=82+(R2-RMRS)*(B2*R2/RC-B2)/(P2-RC)
000199
                        DHIMP=0.5*(CLC1*TMC1*HMC1/(TMC1+HMC1)+CLC2*TMC2*HMC2/(TMC2+HMC2)+
000110
                       1clc3*TMC3*HMC3/(TMC3+HMC3)+CLRS*TMRS*HMRS/(TMRS*HMRS))/CLIMP
000111
                        DHTOT=(CLIMP*DHIMP+CLIND*DHIND)/CLTOT
000112
                        SM=CLC1*RMC1*SIN(BBC1R)+CLC2*RMC2*SIN(BBC2R)+CLC3*RMC3*SIN(BBC3R)+
000113
000114
                       1cLRS*RMRS*SIN(BB2R)
                        GO TO 999
000115
                     31 KP1=0.5
000116
```

	naconge #428/50 #1 * 100 g	DATE 28 APR TV PAGE 28
000117	KP2=K/1 '	•
000118	CLP1=KP1*CLIMP	
000119	CLP2=KP2*CLIMP	and the control of th
000129	GO TO 40	
000121	32 IF (NZ+3) /33,33,34	
000122	33 ZDN=2,*(Z0+Z1)+Z2+Z	
000123	KP1=0.3333	to a contract the contract of
000123	KP2=KP1	
000125	KP3=KP1	
000126	CLP1=KP1*CLIMP	
000127	CLF2=CLP1	
000127	CLP3=CLP1	
000128	GO TO 40	
	34 IF(NZ-4): 35,35,999	
000130		
000131	35 ZDN=3.*(20+Z1)+2.*Z2+Z3+Z	
000132	KP1=0.25	
000133		
000134	KP3=KP1	
000135	KP4=KP1	
000136,	CLP1=KP1*CLIMP	
000137	CLP2=CLP1	
000138	CLP3=CLP1	
000139	CLP4=CLP1	
000140	40 IF(CLP1-CLC1) 41,41,42	
000141	41 DLC11=CLC1-CLP1	
000142	RP2=RC2-0.259*SIN(BBC1R)*DLC11	
000143	GO TO 50	
000144	42 IF (CLP1-CLC1-CLC2) 43,43,44	
000145	43 DLC21=CLC1+CLC2-CLP1	
000146	RP2=RC3-0.707*SIN(BBC2R)*DLC21	
000147	60 10 30	to the figure of the other tests to the second of the seco
000148	44 IF(CLP1-CLTS) 45,45,46	
000149	45 DLC31=CLTS-CLP1	
000150	RP2=RC-0.965*SIN(BBC3R)*DLC31	
000151	GO TO 50	
000152	46 OLR1=CLIMP-CLP1	
000153	RP2=R2-SIN(BB2R)*DLR1	
000154	50 RM2=SORT(0.5*(RM1**2+R22**2))	
000155 .	50L2=CLP1*(Z0+Z1)/(6.28318*RM2)	
000156	HM2=R2*B2/RC+(RC-RM2)*(H-B2*R2/RC)/(RC-RM1) in the contract of the contr
000157	IF(CLP1-CLC1) 60,60,61	
000158	60 SNBM2=SIN(BBC1R)	
000159	GO TO 70	•
000160	61 IF(CLP1-CLC1-CLC2) 62:62:63	
000161	62 SNBM2=(CLC1*SIN(BBC1R)+(CLC2-DLC21)*SIN(BB	C2R))/CLP1 '
000162	60 TO 70	
000163	63 IF(CLP1-CLTS) 64,64,65	
000164	64 SNBM2=(CLC1*SIN(BBC1R)+CLC2*SIN(BBC2R)+(CL	C3-DLC31)*SIN(BBC3R))/CL
000165	1P1	
000166	GO TO 70	
000167	65 SNBM2=(CLC1*SIN(BBC1R)+CLC2*SIN(BBC2R)+CLC	3*SIN(BBC3R)+(CLRS=DLR1)
000168	1*SIN(8B2R))/CLP1	
000169	70 TM2=6.28318*RM2/(Z0+Z1)*SNBM2-0.157	
000169	DH2=TM2*HM2*0.5/(TM2+HM2)	The second of the second species as a second
	IF (NZ+3) 75,76,76	
000171		
000172	75 RM3=SGRT(0.5*(RP2**2+R2**2))	
000173	HM3=B2+(R2-RM3)*(B2*R2/RC-B2)/(R2-RC)	
000174	SOL3=CLP2*Z/(6.28318*RM3)	
000175	SOLTO=SOL1+SOL2+SOL3	
000176	SOLIP=SOL2+SOL3	

1		DATE 28 APR 78 PAGE 23
	000177	IF(CLP1-CLC1) 80:80:81
- A	000178	80 SNBM3: (DLC11*SIN(BBC1R)+CLC2*SIN(BBC2R)+CLC3*SIN(BBC3R)+CLRS*SIN(B
4	000179	1g23)1/CLP2
	000180	GO TO 90
3	000181	81 IF (CL91-CLC1-CLC2) 82,92,83
<u>a</u> ,	000131	82 SNUM3=(DLC21*SIN(BBC2R)+CLC3*SIN(BBC3R)+CLRS*SIN(BB2R))/CLP2
F.	000183	60 To 90
i -	000184	83 IF (CLP1-CLTS) 84.84.85
<i>9</i> .		84 SNBM3::(DLC31*SIN(BBC3R)+CLRS*SIN(BB2R))/CLP2
à	000185	60 TO 99
-	000186	85 SNEM3:SIN(B62R)
g.,	C0U187	
3 '	000188	90 TM3=6.28318*RM3/Z*\$NBM3=0.157
À	000189	DH3=TF/3*FM3*0.5/(TM3+HM3)
4	000190	DHIMP=(CLP1*DH2+CLP2*DH3)/CLIMP
3	000191	DHIOT=(CLIND*OHIND+CLIMP*OHIMP)/CLIOT
1 _	000192	SM=(CLP1::RM2*(20+Z1):*SNBM2*CLP2*RM3*Z*SNRM3)/Z
1	000193	GO TO 999
1	000194	76 CTRY=CLP1+CLP2
4	000132	IF(CTRY-CLC1) 100,100,101
4	000196 .	100 DLC12=CLC1-CTRY
4	000197	RP3=RC2-0.259*SIN(BBC1R)*DLC12
1	000198	60 TO 110
1 -	000199	101 IF(CTRY-CLC1-CLC2) 102,102,103
\$	000200	102 plc22=clc1+clc2=cTRY
4	000201	RP3=RC3-0.707*SIN(BBC2R)*DLC22
§ -	000202	60 TO 110
}\	000203	103 IF(CTRY-CLTS) 104,104,105
1	000204	104 ptc32=ctrs-ctry
3	000205	RP3=RC-0.965*SIN(BBC3R)*DLC32
đ١	000206	GO TC 110
4	000207	105 DLR2=CLIMP-CTRY
,	000208	RP3=R2-SIN(B92R)*DLR2
3	000200	110 RM3=SGRT(0.5*(RP2**2+RP3**2))
	000210	HM3=R2*B2/RC+(RC=RM3)*(H=02*R2/RC)/(RC=RM1)
3 -		SOL3=CLP2*(Z0+Z1+Z2)/(6.28318*RM3)
} -	000212	IF(CTRY-CLC1) 111,111,112
g ·	000213	111 SNBM3=SIN(BBC1R)
1	000213	60 TO 130
\$	000214	112 IF(CTRY-CLC1-CLC2) 113,113,114
1		113 SNBM3=((CLC2-DLC22)*SIN(BBC2R)+(CLC1-CLP1)*SIN(BBC1R))/CLP2
j	000216	The state of the s
3,	000217	60 TO 130 114 IF(CTRY-CLTS) 115:115:116
	000218	115 IF(CLC1-CLP1) 117,117,118
	000219	115 1F(CLC1=CLP1) 11//11//118 117 SNBM3=(DLC21*SIN(BBC2R)+(CLTS=DLC32)*SIN(EBC3R))/CLP2.
%	000220	
3	000221	GO TO 130 118 SNBM3=((CLC1-CLP1)*SIN(BBC1R)+CLC2*SIN(BBC2R)+(CLC3-DLC32)*SIN(BBC
3 -	000222	
d.	000223	13R))/CLP2
ď.,	000224	60 TO 130
3 -	000225	116 IF(CLC1-CLP1) 120,120,119 119 SNBM3=((CLC1-CLP1)*SIN(BBC1R)+CLC2*SIN(BBC2R)+(CLC3-DLC32)*SIN(BBC
11.	000226	113 PNRWD-7770701-078-078-078-078-278-078-278-078-078-078-078-078-078-078-078-078-0
3	000227	13R)+(CLRS-DLR2)*SIN(BB2R))/CLP2
1	000228	60 TO 130
7	000229	120 IF(CLC1+CLC2-CLP1) 121,121,122
(1)	000230	300 FORMAT(//10x,*LC1+LC2-LP1 IS ZERO OR NEGATIVE, NZ=3*.//)
3	000231	121 WRITE (3,300)
	000232	60 TO 999
()	000233	122 SNBM3=((CLC2-DLC21)*SIN(BBC2R)+CLC3+SIN(BBC3R)+(CLR5-DLR2)*SIN(BB2
1	000234	1R))/CLP2
351 -	000235	130 TM3=6.28318*RM3/(Z0=Z1+Z2)*SNBM3-0.157
3	V // U I U U	

	DAIL 28 APR 72 PAGE 24
000237	1 ¹ (\(\nabla \pi - 3\) 135,136
0/0238	135 RM4=509T(0.5% (RP3**2+R2**2))
000239	HM4::D2+(R2-RM4)*(B2*R2/RC-B2)/(R2+RC)
000340	SOL 4::CL.P3*Z/(6.28318*RM4)
000241	SOLTOHSOL1+SOL3+SOL4 SOLIDHSOLTOHSOL1
000242	30011 - 30010
000243	IF(CTRY-CLC1) 140,140,141 140 SMBRAE(DLC12*SIN(BBC1R)+CLC2*SIN(BBC2R)+CLC3*SIN(BBC3R)+CLRS*SIN(B
000244	
000245	182R:)/CLP3
000246	GO TO 150
000247	141 IF(CTRY-CLC1-CLC2) 142,142,143 142 SNBM4=(DLC22*SIN(BBC2R)+CLC3*SIN(BBC3R)+CLRS*SIN(BB2R))/CLP3
000248	
000249	60 70 150
000250	143 IF (CTRY-CLTS) 144,144,145
000251 .	144 SNBM4=(DLC32*SIN(BBC3R)+CLRS*SIN(BB2R))/CLP3
000252	60 TO 150
000253	145 SN9M4#SIN(BB2R)
000254	150 TM4=6.28318*PM4/Z*SNBM4
000255	DH4=1W4*HW4*0*2/(1W4*HW4)
000256 /	DHIMP:::(CLP1*DH2+CLP2*DH3+CLP3*DH4)/CLIMP
000257	DHTOT=(CLIND*DHIND+CLIMP*OHIMP)/CLTOT
000258	SM=(CLP1*RM2*(Z0+Z1)*SNBM2+CLP2*RM3*(Z0+Z1+Z2)*SNBM3+CLP3*RM4*Z*SN
000259	18M4)/Z
000260	60 TO 999
000261	136 CLPT=CLP1+CLP2+CLP3
000262	IF(CLPT-CLC1-CLC2) 160,160,161
000263	160 DLC23=CLC1+CLC2+CLPT
000264	RP4=RC3-0.707*SIN(BBC2R)*DLC23
090265	GO TO 165
000256	161 IF(CLPT-CLTS) 162,163
000267	162 DLC33=CLTS-CLPT
000268	RP4=RC-0.965*SIN(BBC3R)*DLC33
000269	60. TO 165
000270	163 DLR3::CLIMP-CLPT
000271	RP4=R2-SIN(BB2R)*DLR3
00027 2	165 RM4=50RT(0.5*(RP4**2+RP3**2))
0002 73	HM4=R2/RC*B2+(RC-RM4)*(H-B2*R2/RC)/(RC-RM1)
000274	S0L4=CLP3*(Z0+Z1+Z2+Z3)7(6•28318*RM4)
0002 75 '	IF(CLPT-CLC1-CLC2) 170:170:171
000276	170 IF (CLC1-CLP1-CLP2) 172+172+173
000277	172 SNBM4=SIN(BBC2R)
000278	GO TO 190
000279	173 SNBM4=(DLC12*SIN(BBC1R)+(CLC2-DLC23)*SIN(BBC2R))/CLP3
000280	60 TO 190
000281	171 IF(CLPT-CLTS) 174.174.175
000232	174 IF(CLC1-CLP1-CLP2) 176,176,177
0.00283	176 SNBM4=(DLC22*SIN(BBC2R)+(CLC3-DLC33)*SIN(BBC3R))/CL°3
000284	GO TO 190
000285	177 SNBM4=(DLC12*SIN(BBC1R)+CLC2*SIN(BBC2R)+(CLC3-DLC33)*SIN(BBC3R))/
000236	1CLP3
000287	GO TO 190
000288	175 IF(CLC1+CLC2-CLP1-CLP2) 179,179,178
000289	178 SNBM4=(DLC22*SIN(BBC2R)+CLC3*SIN(PBC3R)+(CLRS-DLR3)*SIN(BB2R))/CLP
000290	13
000290	60 TO 190
V V V L. J A	179 IF(CLTS-CLP1-CLP2) 180,180,181
000292	
000292	301 FORMAT(//10X++ 1TS-(1P1+1P2) IS ZERO OR NEGATIVE+ NZ=4++//)
000293	301 FORMAT(//10X,* LTS-(LP1+LP2) IS ZERO OR NEGATIVE * NZ=4*,//)
	301 FORMAT(//10x,* LTS-(LP1+LP2) IS ZERO OR NEGATIVE. NZ=4**//) 180 WRITE(3:301) 60 TO 999

	0.00_Nr _20.50/1/100,	A STATE OF THE PARTY OF THE PAR		ATE 28 APR 72	PAGE 25	and the same of the same	and the country of th
				VIE ZO NEK 12	71.000 25		
000297	190 TM4=(6.28318*RM4)/(Z0+Z1+			······································			
000298 000299	DH4=TM4*HM4*0*5/(TM4+HM4) RM5=SQRT(0*5*(RP4**2+R2**						
000300	HM5=82+(R2-RM5)*(R2*R2/RC		•				****
000301	SOL5=CLP4*Z/(6.28318*RM5)						
000302., 000303	SOLTOWSOL1+SOL2+SOL3+SOL4 SOLIPWSOUTO#SOL1	+S0L5		•			
000304	IF(CLPT-CLC1-CLC2) 200,20	0,201	च जंगक च				
000305	200 SNBM5=(DLC23*SIN(BBC2R)+C	LC3*SIN(BBC3R)+CLRS	*SIN(BB2R))/CL	_P4		•	
000306	GC TO 205				· · · · · · · · · · · · · · · · · · ·		·····
000307 000308	201 IF(CLFT-CLTS) 202,202,203 202 SNBM5=(DLC33*SIN(BBC3R)+C			1.0			
000309	GO TO 205	LR3+51N(BB2R)//CLES		:			
000310	203 SNEMS=SIN(BB2R)	+*					
000311 .	205 TM5=6.28318*RM5*SNBM5/Z-0				•		
000312 000313	DH5=TM5*HM5*0.5/(TM5+HM5) DH1MP=(CLP1*DH2+CLP2*DH3+		CI TMP	 			, , , , , , , , , , , , , , , , , , ,
000314	DHTOT=(CLIMP*DHIMP+CLIND*		CETIM		•		•
000315	SM=(CLP1*RM2*(Z0+Z1)*SNBM	2+CLP2*RM3*(Z0+Z1+Z	2) *SNBM3+CLP3*	*RM4*(Z-Z			
000316,	14)*SNBM4+CLP4*RM5*Z*SNBM5		COC (DDOD) (CTU)	(0000) 00		i	
000317 .	999 DIMP=1AB1/A2*SIN(BBM1R) 1S(BBM1R)/SIN(BBM1R))/(2.*		COSTBBZZIISINI	LDB2R7=CU		i .	
000319	DPIMP=DIMP	344111110000000000000000000000000000000					
000320	RETURN					/ .	
000321	END					······································	
. •		• •			•		
						•	
****						<u> </u>	
			, ,				
						<u> </u>	· · · · · · · · · · · · · · · · · · ·
		*,	•			*	
•		A Property of the Control of the Con	·				
				• 1			
		•			•	Service Control	

						•	
		•					
•						•	
		·					
			•		·	•	
		· ·		F 3 3 27 1 1		34	
						•	

2 3

, end he is a second

-	\ E	! T	T٨	IDI 1	٦٠.	. 1 .	71	D/I	つツ	61 X	1	1 1	

				The Aughter Co. To
	000001			
	000002	SUBROUTINE INPUT		
	000002	REAL KEMID		
	000004	COMMON		
	000005	COMMON DHIRMISHERARC BBMISCLINDSTHINDSZLSDHINDSBLKISAISABISDPIND		
			•	
	000006	1,8862;8863;CLC1;CLC2;CLC3;CLT5;THC1;THC2;THC3;THT5;CLR5;THR5;		
	000007	2CLIMPTHIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL4, SOL4, SOL5, SOLIP, SOL		
	000008	3T0+0H2+0H3+0H4+0H5+DH1MP+DHT0T+RP2+RP3+RP4+SM+QI+SIG+DR+CM2+SCL		•
	000009	COMMON DT1:EPS:02:B8T1:B82:Z:Z0:Z1:Z2:Z3:Z4:NZ:K3MID:XSI:DPIMP		
	000010	COMMON WP, XN, RHO, CKI, HNPSH, HTOT, PHIMN, VHKM, ETAHI, PSITH, ESHR, RWR		
	000011	COMMON XKPH1;PH121;PH122;PH123;CM1;UT1;PH11T;5;XNS;PS10;PH12;NCASE	•.	•
		COMMON FLAG, VIS, FLACO, WWR, V2, PSIDL, DPIPS, PSIIP, PSIIN, FRD	- i	
	000013	COMMON B4,RL,REX,R4,BETA,BFL4,ZD,DINLT,DISTH,TIN,TOUT,XL,V5,		
	000014	1RADUS(95);THETA-RADTH;ALPHA:RAD;DELTA-SAMMA;ARO;RAR;RLOC;CVAN;		
	000015	2ANVAN,BKB,DIFBC,RDIS,ADIS,THICK,THICO,STANG,TRACO,SDLID,RBM4		
	000016,	JABMS.FEE.ACROS.AEW.ABS1.DH.AR.ATHT .PI.NOGO.NSKIP.OPTFI.PRINT.FI2		I
	000017	COMMON RIOPT, RIBM, RIBL, RIBH, DEL, BFL5, DEO, RMTH, OMPR, OMEW, OMOV		,
	000018	COMMON V4.M. XKDVD.XK1VD.XXFVD.EVD.FLA, XKQD.0.QD.OMIOT	<u> </u>	
	000019	COMMON RPHG, SSTHG, FSTHG, XKSFS, XKMSC, D4, D7, C7, DPSSC, DPSFS, DPSMC, C34	•	<u> </u>
٠.	000020	COMMON REBET, RLZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, B9		
	000021	COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5		
	000022	1 FORMAT(10F8.3)		
	000023	BEAD(2:1) WP:XN:RHO:GKI:HNPSH:HTOT:EPS:PHIMN:BD2:VHKM	•	
	000024	510 FORMAT (7F6-3-16-F6-4-3F6-3-F8-5)		
	000025	READ(2,510) SOL1,Z0,Z1,Z2,Z3,Z4,KBMID,NZ,SCL,SIG,DR,FLAG,FLACO		
	000026	520 FORMAT(12F6.4,E8.4)	r	•
	000027_	READ(2,520)XKPH1,PH121,PH122,PH123,ETAH1,Z,XKQD,DINLT,RL,REX,RLBE		
	000028	1T,RLZD,XKMSC		
	000029	530 FORMAT (4F6.3,F12.4,F6.3,F8.3,F10.4,E10.4)		
	_000030	READ(2,530) OPTFI,SBETA,SZD,FRD, FLA,RPHG,FSTHG,SSTHG,VIS		
	000031	540 FORMAT(E8.3,4F8.4,E10.4,5F6.3)		
•	000032	READ(2,540) XKFVD,XKDVD,XK1VD,EVD,FLAHG,XXSFS,CLUT,FINC,9E10,ZRV,		
	000033	109		
	000034	550 FORMAT(SF6+3) READ(2:550) B9:RBRM: R367: THRV:RDSV		
,	000035 000036	4 FORMAT(1H1)		w
		2 FORMAT(5X, ****** INPUT ********//)		
	000037	10 FORMAT(1X, 'FLOW RATE, WP', 23X, F10.3, 2X, *LB/SEC', 8X, *DIFF BLADE IN		
	000038 000039	1LET THICKNESS, DINLT', 7X, F10.3, 2X, 'INCH')		· **
	000040	12 FORMAT(1X, TOTAL HEAD RISE, HIOT:,15X,F10.3,2X,FT1,12X, DIFF LENG	····	
	000041	1TH TO THROAT RATIO, RL', 9X-F10-3, 2X, *****)		
1	000041	14 FORMAT(1X, 'ROTATIONAL SPEED, XN', 16X, F10.3, 2X, ** ** ** ** ** ** ** ** ** ** ** ** **		
	000042	insion RATIO, REX', 15X, =10.3, 2X, '***')		
	000044	16 FORMAT(1X*'NET POSITIVE SUCTION HEAD, HNPSH**4X*F10.3*2X**FT**12X*		
	000044	1:RANGE, DIFFUSER INLET BLADE ANGLE, RLBET', F10.3,2X,*****)	:	•
	000045	18 FORMAT(1X, FACTOR RECIRC FLOW, IMPELLER, OK1', 3X, F10, 3, 2X, ****, 11		
	000047	1X, MAX DIFF BLADE NUMBER, RLZD', 13X, F10, 3, 2X, *****)	ì	• .
,		20 FORMAT(1X, 'FACTOR RECIRC FLOW, DIFFUSER, XKQD', 2X, F10.3, 2X, *****,1		· ·
	000048	11X, SURFACE FINISH, IMPELLER, XKMSC', 9X, E10.4, 2X, 'IN')		
:	000049	21 FORMAT(63X, 'FLOW COEFFICIENT FACTOR, XKPH1', 10X, F10, 3, 2X, '****')		•
!	000050	22 FORMAT(1X, 'FLUID DENSITY, RHO', 18X, F10, 3, 2X, 'LB/FT**3')	! '	•
	000051	24 FORMAT(1X, FLUID DYNAMIC VISCOSITY, VIS', 8X, E10.4,2X, LB*S/SOFT*)	-4	
	000052	26 FORMAT(1X, 'IMPELLER INLET HUB RATIO, EPS', 7X, F10.3, 2X, '***', 11X, 'B		• • •
?	000053	1LADE TIP CLEARANCE, SCL. 16X, F10. 3,2X, 1NCH.)		and the second s
	000054			
	000055	28 FORMAT(1X, 'INDUCER SOLIDITY, SOL1', 14X, F10.3, 2X, ****', 11X, 'DIFF LO	.]	
)	000056	16 SPIRAL ANGLE, SELECTED, SBETA*,2X,F10.3,2X,*DEG*)		•

أنعلفس	and the same of th		والمراجع والمتحارض والمتحارض والمحارض والمتحارض والمتحار	المانية في المناف المانية المانية	and the same of the same	r de Me. Persona an estado a	A dokumenta maka
1		BPURER, 427255, 1, 100	DATE	28 APR 72	PAGE 27	and the state of t	ta e de l'alla de la Calaba de l
4	000057	30 FORMAT(1X+ TIMP MIN INLET TIP FLOW	COPER DUTUNG TYPE TO TON				
- 7	000058	111X. DIFF BLADE NUMBER, SELECTED,	COEFF FRIENT FIX FE TO STEAM	****	 		
4.	000059	30 ECOMATITY OUR DANGER TO DANAHAS	52U'16X1F1U*312X1******)	:			
, i	000060	32 FORMAT(1X, MIN CAVITATION PARAMET	EK! VMKM' (6X) F10.3.2X, *****)			ر. ومعيه د.	
ાં -		34 FOR MAT (1X, 'IMP DISCHARGE BLADE AN	GLE, BR2',6X,F10.3,2X, 'DEG',	11X.		•,	-
1	000061	1FRICTION COEFF. DIFFUSER, FRD: 11	X,F10.4,2X,*****)				
4	000062 .	36 FORMAT(1X. TIMP. BLADE ANGLE DISTR	FACTOR, KBMID',1X,F10.3,2X,	****			
	000063	111X; "VOLUTE SURFACE FINISH; XKSFS	*,12X,F10,4,2X,*****			· •	
4	000064	38 FORMAT (1X, TOT NUMBER OF IMP BLAD	S, Z'. 9X,F10.3,2X, *****	X D1		-	
	000065	1FF LOSS ADJUSTMENT FACTOR, FLATA	X.F10.3.2X.*****)		* *		
13 23	000066	40 FORMAT (1X. INITIAL HYDRAULIC EFFI	CIENCY, ETAHTI, IX. Eta. 3.24.	***!		.•	
Sec.	000067	42 FORMAT (1X. IMPELLER CONFIGURATION	• El AG1.8Y.E10 3.2V. (******	V . • 14 A			
灣	000068	1X TO DESIGN PRESSURE RATIO, RPHG.	· 67.E40 %.00. ********************************	AF YMA			
4	000069	44 FORMAT (1X. PADIAL EXTENSION OF IM	DONTE TO A DECEMBER OF THE ATTRACT				
·-	000070	17. THOUSE MATERIAL VIEW OF THE	_ DISC DE AXALIDOS SX TING	H',10		· · · · · · · · · · · · · · · · · · ·	
.隋、	000071	1X. POUSING MATERIAL YIELD STRENGT	Hr 551H51/2X/F10.3)		•		
4	600072	46 FORMAT(1X, LABYRINTH CLEARANCE FA	10R+ FLACO'+3X+F10.5+2X+**	**,11			
₹ -	000073	1X, HOUSE SAFETY FACTOR, FSTHE 1,14	X+F10.3,2X,*****)				
1		48 FORMAT (1X, TIP CLEARANCE LOSS FAC	TOR, SIG',6X,F10.3,2X,****)	•		•	
3	000074	50 FORMAT(1X, FLOW COEFFICIENT OPTIM	IZATION, OPTFI:1X,F10.3,15X,	*INLE		•	
	000075	IT BLADE THICKNESS, THRV:,13x,F10.	3,2×,11N1)				
	000076 .	54 FORMAT(1X, PHI21=1, FA, 4, 5X, PHI22	"'.F8.4,5X,'PHI23='F8.4,10X,	*REVE			
্ৰু)	000077	IRSING VANE DISCHARGE DIA, D91,8X,	F10.3,2X,'TN')	• '			
- I	900078	55 FORMAT(1X, HOUSING CONFIGURATION,	FLAHG * + 8X + F10 + 3 + 2X + * * * * * * * 11	Y . 1511		<i>.</i>	
4	000079	1REACE FINISH, DIFFUSER, XKEVD, o	(,F10,4,2X,*****)				
(d)	000080	57 FORMAT (63X, DIFFUSION LOSS FACTOR	DIFFUSER, XKDVD1.24.E10.3.	2Y . 1 w	•		
	000031	1***)		!		,	
ું કું	000082	59 FORMAT (63X . INCIDENCE LOSS FACTOR	DIFFUSER. XKIVDI.24.F10.3.	2Y. **			
3	000083	1***)	SIN SERVI MILLED FEATH LOUGH	EAF . T			
1	1000084	61 FORMAT (63X) DIFFUSION EXPONENT, D	FEHCED, EVAL. TV. ELA T. AV				
-	000085	69 FORMAT(63X, RATIO B/RM U-TURN, RB	M1.17V.E10 3.0V. (***/	·		
D	000086	73 FORMAT (63X . PORT WIDTH REVERS VAN	C DISCUADOS DOLLOS DA 2.00				
1	000037	1*)	DISCUSSION DAILANTEIN DISSY	1.10			
-	000088	75 FORMAT(63X, RATIO B6/87, RB671, 23)	(.C10 7.3V. ()				
ાં કું}	000089	77 FORMAT (63X) FRIC LOSS COEFF, VANEL	FEE THINK OLUTE BY CAR F AV				
ું	000090	1*)	-F22 LOGGE CEOL, 14X16 TO 215X	****			
ିଞ୍ଚ ~	000091	79 FORMAT (63X . OPTIONAL INPUT - RETU!	NI CUANCEL AS				
\$3	000092	81 FORMAT(63X, NUMBER OF REVERSING V	INCO TONA 104 MAD TO THE			• .	
ige .	000093	85 FORMAT (63X + DIAMETER RATIO DSV/D9	THEU, SHY FIUX FIUX 5 2X 1 ***	' '			
্ৰ –	000094	103 FORMAT (63X, FLUID ANGLE REVERS VAI	119A1F (U.S)ZX(T*****)		····		
and the same	000095	* IDEG*)	IE DISCHARGE, BEID, IX, EID.3	,2X,		*	
8	000096				•	•	
_	000097	105 FORMAT(1X, 20=1, F3, 1,5X, 21=1, F3	1.5X.122=1.F4.1.5X.123=1.F4	•1•5X			
1	000097	1, '24=', F4.1, 9X, 'ANGLE CORRECTION F	ACTOR, FINC, 11X, F10.3,2X,	****/		•	
1	000099	2)	25 24				
- A		106 FORMAT(1X. BLADE SCHEDULE. NZ = 1	12./)	· · · · · · · · · · · · · · · · · · ·			
1		200 FORMAT(1X, 'ALTERNATE FLOW COEFFIC'	ENTS')		•	,	
3	000101	WRITE(3,4)					
Á	000102	WRITE(3,2)					
3	000103	WRITE(3,10) WP.DINLT -		,		•	
3	000104	WRITE(3,12) HTOT,RL			*		
4	000105	WRITE(3,14) XN,REX					
	000106	WRITE(3,16) HNPSH, RLBET					
(A)	000107	WRITE(3,18) QKI,RLZD				•	
1 _	000108	WRITE(3,20) XKQD,XKMSC	ϵ_{ij}		*		
3	000199	WRITE(3,21) XKPH1				*	
製)	000110	WRITE(3,22) RHO			•		
3	000111	WRITE(3:24) VIS		e e j	•		
1	000112	WRITE(3,26) EPS,SCL					**************************************
(1)	000113	WRITE(3,28) SOL1, SBETA	 Line of the second secon		•		
1	000114	WRITE(3,30) PHIMM,SZD					į
1	000115	WRITE(3,32) VHKM		· · · · · · · · · · · · · · · · · · ·	1		
3	000116	WRITE(3,34) BB2,FRD		•		•	ŝ
4			· · ·				ŧ

Br 12 880

	SPUTER - 528250 - 1 - 100		DATE 28 APP	R 72 PAGE - 28		
				•	•	•
000117	WRITE:3,36) KBMID,XKSFS		<u> </u>			
000118	WRITE(3,38) Z/FLA					
000119	WRITE 13.40) ETAHI WRITE 13.42) FLAG. RPHG		i e		in the first of the second	.7 4
000120 000121	WRITE 3,44) DR, SSTHG		,			
000122	WRITE(3,46) FLACO, FSTHS		La company of the same		•	
000123	WRITE (3,48), SIG		Kartina da araba da			
000124	WRITE (3,55) FLAHG, XKFVO					
000125	WRITE(3,57) XKDVD		4	*****		
000126	WRITE(3,59), XK1VD		<u> </u>			
000127	WRITE(3:61) EVD		1.			
000128 000129	WRITE(3,106) NZ WRITE(3,103) BE10					
000129	WRITE (3,77) CLUT					
900131	WRITE(3,105) Z0,Z1,Z2,Z3,Z4 .FING					
000132	WRITE(3,79)		1	The state of the s		
000133	WRITE(3,200)		i i i i i i i i i i i i i i i i i i i	•		
000134	WRITE(3,85) RDSV		State of the state			•
000135	WRITE(3,69) RBRM		n. Na katalogia ng mga na mga ng			
000136 .	WRITE(3,54) PHI21.PHI22.PHI23.09		19 1 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		$A_{ij} = A_{ij}$	
000137	WRITE(3,73) B9 WRITE(3,75) RB67		The second secon	•		
000138	WRITE(3,50) OPTFI ,THRV		• •			
000140	WRITE(3:81) ZRV	1 1 1	Action to the second	•	ļ	•
000141	RETURN	**			:	
000142	END			•	2	
			Harris Commence		•	
·			 			
			ing a second contract of the c			
		, ,		·		
				• .	•	
			and the second			
			the second	•		
•						
			100 - 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	•		
			and the state of the second			
		713				
•						
		The state of the s				
			•		•	
			• •			
			· · · · · · · · · · · · · · · · · · ·			
•				:		
•				<u> </u>	·	
		* ·			. 3	

DATE 28 APR 72 PAGE 2

		-		4 1 2 4 4				 and the second	
0	C1	7	7 117	10 . 4	٠.	7 1 N	ルつフ	6.51	1 7

				* .	A CONTRACTOR OF THE PROPERTY O
	000001		SUBROUTINE INT4(X,Y,XI,YO)	61205002	
	000002		DIMENSION X(9) + Y(9) + XC(4) + YC(4)	61205005	
	000003		EQUIVALENCE (XC(1) + X1) + (XC(2) + X2) + (XC(3) + X3) + (XC(4) + X4) + (YC(1) +		the state of the s
	000003		1, (YC(2), Y2), (YC(3), Y3), (YC(4), Y4)	61205007	
			NA=1	01203007	•
	000005				A Committee of the Comm
	000006		J=2	61205009	
	000007		8=XI	61205010	
	000008	21	IF(X(J))26,22,26	61205011	•
	000009	26	GO TO(30,40).NA		
	000010	22	IF(Y(J))26,23,26	61205013	
•	000011 .	23	IF(U-2)24,24,25	61205014	*
	000012	24	YE=0,0	61205015	
	000013		GO TO 50	61205016	
	000014	25	MB=1	• • • • • • • • • • • • • • • • • • • •	•
	000015		J=J-1	. 61205018	•
	000016	27	$x_1=x(J)$	61205019	
	000017	£.,	X2=X(J-1)	61205020	
	000017		X3=X(J-2)	61205020	
	000019		Y1=Y(J)	61205022	1
١	000020	•	Y2=Y(J-1)	61205023	
	000021		Y3=Y(J-2)	61205024	
	000022		GO TO(32,42),NB		
	000023	. 30	IF(X(J)-B)29,37,37	61205026	
	000024	37	IF(J-2)31,31,28	61205027	•
	000025	28	NA=2 ·		
	000026	29	J=J+1	61205029	
	000027		GO TO 21	61205030	
	000023	31	DO 60 U=1.3	61205031	
	000029		XC(U)=X(U)	61205032	
	000030	50	ŶĊ(Ŭ)=Y(Ŭ)	61205033	
	000031	32	D=X2-X1	61205034	
	000032	0.2	A1=B-X1	61205035	
	000033		A2=8-X2	61205036	• •
	000034		YE=A1*A2/2.0/D*((Y3-Y2)/(X3-X2)-(Y2-Y1)/D)-A2/D*Y1+A1/D*Y2	61205037	
	000035		60 TO 50	61205038	
		4. 0		61503030	•
	000036	40	NB=2		
	000037		GO TO 27	61205040	
	000038	42	X4=X(J-3)	61205041	. *
	000039		Y4=Y(J-3)		
	000040			61205043	
	000041	• •	A1=8-X2	61205044 .	
	000042		A2=8-X3	61205045	
	000043		XM12=(Y2-Y1)/(X2-X1)	61205046	•
	000044		XM23=(Y3-Y2)/D	61205047	•
	000045		XM34 = (Y4 - Y3)/(X4 - X3)	61205048	
	000046		YE=A1*A2**2/2.0/D**2*(XM12-XM23)+A2*A1**2/2.0/D**2*(XM34-XM23	3)-A2*61205049	
	000047		1Y2/D+A1*Y3/D	61205050	•
	000048	50	YO=YE	61205051	
	000049		RETURN	61205052	And the second s
	000050		END	61205053	•
	000000		EIND	01203030	

distribution of the later of th	the state of the second	and the second s	DATE 28 APC 77 PA	
(a.4.)*	3,1,100	•	The state of the s	
			:	
a ELT LO	551,1,710427, 63115			
				· · · · · · · · · · · · · · · · · · ·
	The state of the s		***	
000001	SUBROUTINE LOSSI			
000002	DIMENSION X(19),Y(19) COMMON XK(8),XZ(8),XFR(01. V2 (01)	and the second of the second	
000003 000004		11,CLIND, THIND, ZL, DHIND, BLK1, A		
000005		CLC3, CLTS, THC1, THC2, THC3, THTS		
000005		K2, A2, SOL1, SOL2, SOL3, SOL4, SOL5		
000007		HTOT.RP2.RP3.RP4.SM.QI.SIG.DR	CM2+SCL	
800000	COMMON DT1+EPS+D2+B3T1+	BB2, Z, Z0, Z1, Z2, 73, Z4, NZ, KBMID:	XSI.DPIMP TO THE	
000009	COMMON WP+XN+RHO+QKI+HNPSH	HHTOT, PHIMN, VHKM, ETAHI, PSITH,	SHR+RWR 1	
000010	COMMOA XKBHI + BHISI + BHISS + B	HI23.CM1.UT1.PH11T.S.XNS.PSIO	PHI2+NCASE 1	•
000011 .	COMMON FLAG, VIS, FLACO, WWR,	U2.PSIBL.OPIPS.PSIIP.PSIIN.FRI)	
000012	COMMON B4+RL+REX+R4+BETA+B	BFL4,ZD,DINLT,DISTH,TIN,TOUT,XL	.•V5•	
000013		A.RAD.DELTA.GAMMA.ARO.RAR.RLO		•
000014	2 ANVAN+BKB+DIFBC+RDIS+ADIS	THICK, THICO, STANG, TRACO, SOLIC),BBM4.	•
000015		LAR, ATHT RINDGO NSKIP, OPTFI		
000016,		H.DEL.BFL5.DEQ.PMTH.OMPR.OMEW		7
000017			O.O.O.O.O.O.O.O.O.O.O.O.O.O.O.O.O.O.O.	
000018		(SFS.XKMSC.D6.D7.C7.DPSSC.DPSFS	DPSMC+C34	
000019		D.PSHSG.ETAOV.LOOP.FLAHG.89	U DM.RCM5	
000020		+D9+RB67+THRV+ZRV+RDSV+TEX5 +1	JEDM+BCM2	4
000021	500 FORMAT(10X. INCIDENCE LE	SS THAN OPTIFUMITY		
000022	X(1)=1.0 Y(1)=.004	·,		
000023 000024	X(2)=1.2	•		
000024	Y(2)=.0042			
000025	X(3)=1.4			
000026	Y(3)=.0055	•		
000028	X(4)=1.6		3.	
000029	Y(4)=.0085		3.5 A. S.	. '
000030	x(5)=1.8			
000031	Y(5)=.0132		1	
000032	x(6)=2.0	•		·
000033	Y(6)=.02		and the state of t	• .
000034	X(7)=2.1			•
000035	Y(7) = .026			
000036	x(8)=2.2			
000037	Y(8)=.032	•		·
000038	X(9)=2.3			
000039	Y(9)=.0405			
000040	X(10)=2.4			
000041	Y(10)=.05			
000042	X(11)=2.5			
000043	Y(11)=.064			
000044	X(12)=2.6 Y(12)=.08			
000045	X(13)=2.7			
000045 000047	Y(13)=.101			•
000047	X(14)=2.75			
000048	Y(14)=.114			3
000050	X(15)=2.8			
000051	Y(15)=•13			
000052	X(16)=2.85			
000053	Y(16)=.149	•		·
000054	X(17)=2.9			
000055	Y(17)=.174		1 .	· ·
000056	x(18)=2.95		i i	

	DATE 28 APR 72 PAGE . 31
The State of the S	
فتنفض مستنه والترييس والما	DPDPLR, 428; 50:1,100;
200-2:200-2	
	Y(10)::•21
000057	
	X(19)::2.90 Y(19)::999999. RIO10::425*(903BM4) RKTH=:-007636+19.612*THICO-132.6273*THICO**2+372.96*THICO**3 RKTH=:-007636+19.612*THICO-132.6273*THICO**2+372.96*THICO**3
000059	R1010 007636+19.612*THICO-132.627
0000051	RKIN-1010 RIO-RKTH+RIO10 0145*83M4)*FEE
0000.62	**************************************
000063	
000064	
000065	7 (CORINT) 0,007
000066	4 WRITE(3,500)
000067	6 RIBM=RI/(90.+BBM4)
000068 000069	60 T0 7 5 BFL4=38M4+RIOPT 5 BFL4=38M4+RIOPT
0000070	5 BFL4=88M4+R10 RISM=RIOPT/(90BBM4)
000071	RISM=R10817 - 065 7 RMC=.0058*STANG065
000072	7 RMC=.0058*STANG=.005 RIBL=(BETA-90.+BFL4)/BETA RIBL=(BETA-90.+BFL4)/GAMMA
000073	
000074	
000075	DEL
000075 ,	12 RFL5 = 90BCM5
000077	
000079	
000080	
000081	9 WRITE (3,502) RIOPT WRITE (3,502) RIOPT
ocuo82	
000083	WRITE(3,505) BFL5 WRITE(3,506) RIBH WRITE(3,506) RIBY
000084	WRITE (3,506) RIBM WRITE (3,506) RIBL WRITE (3,506) RIBM WRITE (3,506)
000035	DETE (3,506) RIBL ANGLE, MEAN , 3X, 110.5, DES
000087	FORMAT (05X, ACTUAL INCLES BEL4*, 5X, F10. 3.* DEG*)
880000	17801000 TN(11)ENOC 1000 A DEC(1) 101
000089	TOO EORMAI LUJA
000090	
000091	17FLUID - DISCHARGE FLUID CONTROL - 2X.FLU.37
000092	505 FORMAT(05X, UISETA RATIO, HI PRESS, SIDE, 510.3) 506 FORMAT(5X, I/BETA RATIO, MEAN, 12X, F10.3) 507 FORMAT(5X, I/BETA RATIO, LO PRESS, SIDE, 2X, F10.3)
	506 FORMAT(SX,*I/RETA RATIO, MEAN*,12X,F10.3) 507 FORMAT(SX,*I/BETA RATIO, LO PRESS, SIDE*,2X,F10.3) 508 FORMAT(SX,*I/BETA RATIO, LO PRESS, SIDE*,2X,F10.3)
000095	SOR FORMAT (SX, I/BETA RAILY, S
000096	8 RETURN
000097	END .
000098	
1	
P	
1	
1	
3	

1 -	a a	LT MAIN.1.710427, 63118
		HARMAN AND AND AND AND AND AND AND AND AND A
	000001	DIMENSION PSIHG(12),TBETA(12),TZD(12),OZD(10),OBETA(10),OETA(10)
ļ.,	000002	DIMENSION OPHI2(10)
Í	000003	COMMON XK(8) *XZ(8) *XFR(8) *XR(8)
	000004	COMMON DHI, RM1, H, RA, RC, BSM1, CLIND, THIND, ZL, DHIND, BLK1, A1, AB1, DPIND
j'i	000005	1.BBC1.BBC2.BBC3.CLC1.CLC2.CLC3.CLTS.THC1.THC2.THC3.THTS.CLRS.THRS.
1	000006	2C!.IMP.THIMP.CLTOT.THTOT.RLK2.A2.SOL1.SOL2.SOL3.SOL4.SOL5.SOLIP.SOL
-	600007	JTO.DH2.DH3.DH4.DH5.DHIMP.DHTOT.RP2.RP3.RP4.SM.QI.SIG.DR.CM2.SCL
j.)	000008	COMMON DT1,EPS,D2,B2,BBT1,BB2,Z,Z0,Z1,Z2,Z3,Z4,NZ,K3MID,XSI,DPIMP
1	000009	COMMON WP+XN+RHO+GKI+HNPSH+HTOT+PHIMM+VHKM+ETAHI+PSITH+ESHR+PWR
g	000010	COMMON XKPH1,PHI21,PHI22,PHI23,CM1,UT1,PHI1T,S,XNS,PSIO,PHI2,NCASE
	000011	COMMON FLAG, VIS, FLACO, WWR, U2, PSIBL, OPIPS, PSIIP, PSIIN, FRD
	000012	COMMON 84.RL, REX, R4, BETA, BFL4, ZD, DINLT, DISTH, TIN, TO JT, XL, V5,
Š	000013	1RADUS(95),THETA,RADTH,ALPHA,RAD,DELTA,GAMMA,ARO,RAR,RLOC,CVAN,
	000014	2 ANVAN/BKB/ R5 /RDIS/ADIS/THICK/THICO/STANG/TRACO/SOLID/BBM4/
ĝ.	000015	3BBM5, FEE, ACROS, AEW, ABS1, DH, AR, ATHRC, RI, NOGO, NSKIP, OOTFI, PRINT, FI2
1	000016,	COMMON RIOPT+RIBM+RIBL+RIBH+DEL+BFL5+DEO+RMTH+OMPR+OMEW+OMOV /
()	000017	COMMON V4;M, XKDVD;XK1VD;XKFVD;EVD;FLA; XKOD;0;0D;0MTOT
á	000018	COMMON_RPHG.SSTHG.FSTHG.XKSES.XKMSC.DG.D7.C7.DPSSC.DPSSC.DPSMC.C34
4	000019	COMMON RUBET, RUZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, B9
ă.	000020	COMMON CLUT, FINC, BE10, RBRM, D9, RB67, THRV, ZRV, RDSV, TEX5 , DLDM, BCM5
ž	000021	1 FORMAT(8F10.0)
9	000022	READ(2:1)XK,XZ,XFR,XR
3 .7	000023	400 CALL INPUT
ģ	000024	NCASE=0
4	000025	NEX=0
() ()	000026	MTEST=0
Ş	000027	K=0
έ.	000028	N060=0
å-`	000029 000030	IF(WP)401,500,401
1	0000330	401 CALL SIZE1 IF(NOGO) 404,404,405
1	000032	1F (NOSO) 40474047405 405 WRITE (37406)
∯-2	000032	406 FORMAT(/////5X, INPUT VALUE OF BB2 NOT ACCEPTABLE , ////)
§	000033	60 10 400
h	000035	404 1=0
j-	000036	IF(PHI21) 280,280,279
į	000037	279 OPTF1=0
	000031	225 IF(NCASE-1) 226,228,230
	000039	226 PHI2=PHI21
1	000040	NCASE=1
80	000041	60 TO 280
\$	000042	228 JF(PHI22) 400,400,232
} —	000043	232 PHI2=PHI22
(I)	000044	NCASE=2
	000045	60 TO 280
3	000046	230 IF(NCASE-2) 228,231,400
	000047	231 IF(PHI23), 400,400,234
<u> </u>	000048	234 PHI2=PHI23
	000049	NCASE=3
3	000050	280 PRINT=0
2	000051	289 L00P=0
7	000052	NSKIP=0
3	000053	IF(I-10) 300.300.295
- L	000054	295 WRITE(3,296)
3	000055	296 FORMAT (////5x, FLOW COEFFICIENT OPTIMIZATION, LIMIT OF ITERATIONS
(1)	000056	1EXCEEDED*)

2.0 00000000000000	All the second and th	de la companya de la
	DATE 28 AVR 72 PAGE	
000057 000058	GO TO 400 , 300 CALL SAFE ,	
000059	CALL NAGEO	
000060	IF (PRINT) 153/153/151	and the state of t
000061	151 CALL ANSWR	
.000062	153 CALL LOSS	
000063	CALL DERBY	
000064	IF (FLAG-1.) 130,30,130	•
000065	130 IF(FLAG=3.) 35.30.35	
000066	35 wwx=0 • 11 still 1	The state of the s
000067	30 CALL CLAS	
000068		
000069 000070	31 IF(FLAHG-3.) 33,33,32	
000071	60 TO 301	
000072	32 DISTH=2.*DINLT	•
000073	CU2TH=PSITH*U2	
000074	C2=SQRT(CU2TH**2+CM2**2)	
000075	ALP2R=ATAN(CM2/CU2TH)	
0000767	. CM3=CM2*(1BLK2)	1
000077	R4=.5*D2*(.000157*XNS**.917+1.)	
000078	D4=2.*R4	
000079	B4=1.10#32	\cdot . In the second of t
000080	ALP4=ATAN(CM3/CU2TH)*57.296	• • •
000081	BFL4=90 ALP4	
000082 000083	VU4=D2/D4*CU2TH ALP4R=ALP4/57•296	
000034	V4=VU4/COS(ALP4R)	
000085	ALP2=57.296*ALP2R .	
000036	C3=SGRT(CU2TH**2+CM3**2)	i
000037	C34=0.5*(C3+V4)	i e e e e e e e e e e e e e e e e e e e
000088	VTHRC=C2*EXP(0.37532-0.286*ALOG(ALP2))	•
000039	OD=Q*(1.+XKOD)	
000090	ATHRC=+321*00/VTHRC	
000091	ATHRC=1.1*ATHRC	1
000092	IF(SBETA) 43,43,42	
000093	42 BETA=SBETA	
000094	zo=szo	
000095 000096	60 TO 44 43 ZD=7.	•
000097	BETA=FLOAT(IFIX(ALP45))	
000097	SAVE=BETA	
000099	44 MEO	
000100	45 TIN=ATHRC/B4/ZD	
000101	TOUT=REX*TIN	
000102	XL=RL*TIN	
000103	46 IMESS=0	
000104	CALL GEOM(IMESS.N)	
000105	IF (IMESS) 79 + 4 - 79	
000105	79 IF(SBETA) 80,80,408	•
000107	408 WRITE(3,410) 410 FORMAT(10X*MORE THAN 30 ITERATIONS IN SUBROUTINE GEOM*)	
000108 000129	60 TO 400	
000110	4 CONTINUE	
000110	C. ACCEPTANCE CRITERIA FOR BLADE PROFILE	<u> </u>
000112	IF (FLANG-6.) 101,101,49	
000113	101 IF (ARO-8KB) 84,84,49	
000114	49 IF((GAMMA-BETA)-1.5) 84,50,50	
000115	50 IF((GAMMA-BETA)-5.5) 61.61.84	
	84 IF(SBETA) 80,80,72	

	IE(061E1) ST2*ST2*ST2 		ZT000
	00 10 300	1,2	41000
	FOOb=FOOb+1 IE(FOOb-S) SIS'SI#'SI#		/1000 /1000
	IE(PRINT) 210,210,220		71000
	ETAHI=(PSIIP-PSIH6(LMIN))/PSITH		ZT000 :
	ZSD=LSO(FWIN) 28E1V=19E1V(FWIN)		91000 <u></u> 91000
	2BEIV=1BEIV(FWIN) CON11WNE		91000 - s
· ·	ראוא=רשוא+ד	<u> </u>	91000
	PSHMI=PSIHG(L)		91000
1	IE(52HWI-52HR9(F)) 102*102*110 Do 102 F=5*W		9700 0 97000
			91000
	PSENI=PSIHG(1)	160	91000
	60 TO 205		91006
	DSHMI=1 FMIN=1		97000 97000
	00 to 00		21000
V	FORMAT(//5X, NO SOLUTION, RELAX CONSTRAIN"S:/)	96 99	9100 0
	MBILE(3,95)		97000 ·
	JE(XD-32*) #6*#500*190	061/	51000 S1000
	*Z+QZ=QZ		ST000
	<u>06.06.488 (07.18-07)</u> ∃I		
	IE(M) 80,86,90		\$1000
	3vA2=4138 78*68*68 (GZJR)31		νΙ600 νΙ00 0
	50 10 de		hTCnQ
Encountry mental	BETA=8ETA+1.		WI000
	IE (BEIV-SVAE-RUBEI) 85.86.86		Ნ๕ᲜᲘᲑ Ხ๕ᲜᲘᲑ
	PSIHG(M)=PSHSG TF(SGETA) 80,80,200		4.100a
	QZ=(W)QZ1		trT000
	TEETA(M)=RETA		#T000
	IE(NZKIB) 92.92.90		#1600 21000
	CO 10 #00 CORNYI(\\CXY:\NOCO=1: HONZING ZIBNCINBVFFX NOI VCCEBIVBFE:)		\$1000 \$1000
	MAITE(3,414)		000012
<u> </u>	IF(NOGO) 91.91.412		5.1000
	© 10 ×02		01000 21000
	58ETA=0		21000
	IE(FLAMG-3.) 303.303.302	S	CTOUD -
	מערוד פכעהר		21000 21000
1	20 10 92 CALL REVCH		S1000 51000
	E(ECH8-8.), 301.301.304	8	00015
	CALL DBURK	23	21000
	CALL LOSS1 CALL LOSS1 CALL LOSS1		0007S
	PORMIC(3:201)		21000
	בערר יארנגו(א)	1 t1 £	00015
및 - : - :	IF (PR(NT) 73,73,74		S1000
	<pre>*/F6.3/8X/7HASO =:2X/F6.3/8K*7PPKB =:?X/F6.3X) */F6.3/8X/7HASO =:2X/F6.3/F6.3X/ */F6.3/8X/7HASO =:2X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/F6.3X/ */F6.3/8X/ */F</pre>		00075
and the desired of the second	### ##################################		11000
	"BILE(3'217)	8.	11000
***************************************	WRITE(3,610) ZD.BETA.GAMMA.ARO.BKB	ST T.	11000
40 0001	NEW 82 4196	ng gapa	•
No PAGE 30	May 82 31VG		Martine and the second section of

```
DATE 28 APR 72 PAGE 35
                   300 to 1 + 100 to 200 1 + 100
                    215 PRINTEL.
000177
000178
                        GO TC 300
                    216 IF(LOOP-3) 217,218,218
900179
869189
                    217 LOOP=LOOP+1
                        60 TO 300
000181
000182
                    220 IF (NCASE) 400+400+225
000183
                    218 I=I+1
                        oZD(I)=SZD
000184
000185
                        OBETAIL) = SBETA
000186
                        VQATECT) ATBO
000187
                        OPHIZ(I)=PHIZ
                        IF(MTEST) 305,305,340 .
000108
000189
                    305 IF(I-1) 307,307,310
000190
                   307 PHI2=PHI2+0.005
600191
                      5 FORMAT(/5X, ROUTE 3071/)
                        WRITE(3,5)
000192
000193
                        GO TO 290
000194
                    310 IF(I-2) 312,312,314
000195
                    312 IF (OETA(I)-OETA(I-1)) 315,318,320
000196 /
                    320 K=1
000197
                        GO TO 307
                    318 PHI2=0.5*(OPHI2(I)+OPHI2(I=1))
000198
000109
000200
                      6 FORMAT(/5X+ ROUTE 3181/)
000201
                        WRITE(3,6)
000202
                        GO TO 290
£65000
                    315 KEEP=I
01:020#
                        LEAVE=I-1
                        KEEP=LEAVE
000205
001.206
                        LEAVE=KEEP
000207
                        OETA(KEEP)=OETA(LEAVE)
803000
                        OBETA(KEEP)=OBETA(LEAVE)
                        OETA(LEAVE)=OETA(KEEP)
6-03396
                        OBETA(LEAVE) = OBETA(KEEP)
000210
                        OZD (KEEP) = OZD (LEAVE)
000211
                        OZD(LEAVE)=OZD(KEEP)
000012
                        OPHI2(KEEP)=OPHI2(LEAVE)
000213
0000210
                        OPHI2(LEAVE)=OPHI2(KEEP)
900215
                        OETA(KEEP)=OETA(LEAVE)
000216
                        OETA(LEAVE)=OETA(KEEP)
000217
                        PHI2=PHI2-0.010
                      7 FORMAT (/5X, 'ROUTE 315'/)
000218
                        WRITE(3,7)
000219
000280
                        GO TO 290
000221
                    314 IF(OETA(I)-OETA(I-1)) 322,318,324
                    322 IF (ABS(OETA(I)-OETA(I-2))-0.001)326,328,328
000222
                    326 PHI2=0PHI2(I-1)
000223
                        SZD=cZD(I-1)
090224
000225
                        SHETA=OBETA(I-1)
000225
                        MEX=1
000227
                      8 FORMAT (/5X) TROUTE 3261/)
000228
                        WRITE(3,8)
000229
                        60 TO 289
                    328 IF(OETA(I)-OETA(I-2)) 330,326,332
000230
000231
                    330 PHI2=0.5*(OPHI2(I-1)+OPHI2(I-2))
000232
                        MTEST=1
000233
                      9 FORMAT(/5X, ROUTE 3301/)
                        WRITE(3,9)
000234
000235
                        GO TO 290
                    332 PHI2=0.5*(OPHI2(I)+OPHI2(I-1))
000236
```

ەنىلىمىمىيىنىنىدىنىدىنىدىنىدىنىدىنىدىنىدىنىدىنىد		though was office zight fraction of the
0.00237	""EST"1	
000258	10 FCRXA"(/5X, ROUTE 3321/)	
. 200 239	∀RITE(3:10)	the control of the co
- a6920 0	60 10 290	
000241	324 IF (ii) 334,334,307	•
010242	334 PHI2::PHI2-0.005	
000243	11 FORMAT (/5X; ROUTE 3341/)	
000244	WRITE (3,11)	
0.00245	60 TO 290	
690246	340 IF (DETA(I)-DETA(I-2)) 342.34	44,346
009247	342 PHI2=OPHI2(I-2)	
000248	SZ0=0ZD(I-2)	
000249	SBETA=OBETA(I-2)	
UH J250	NEX=1	
900251	12 FORMAT(/5X, ROUTE 3421/)	
60025 2	WRITE(3,12)	
000253	GO TO 289	
000254	344 PHI2=0.5*(OPHI2(I)+OPHI2(I-2	21)
£3025 5	NEX≔1	
600255	13 FORMAT (/5X . 'ROUTE 344'/)	
000257	WRITE(3,13)	
000258	60 TO 290	
309269	346 PHI2=0PHI2(I)	
986260	SZD=0ZD(I)	
600261	SBETATOBETA(I)	
0(0262	NEX=1	
-000263	14 FORMAT(/5X, 'ROUTE 346'/)	
000258	WRITE(3.14)	
01:e26 5	60 TO 289	
000266	290 SBETA=0	
000267	GO TO 289	
895000	500 STOP	
000869	END	
programme and the second second second second		
	•	

.,

.- .- . .

WRITE(3,502)

000056

```
@ ELT OUTP1,1,710427, 63120
```

```
SUBPOUTINE OUTPI(N)
000001
                         COMMON XK(8), XZ(8), XFR(8), XR(8)
000002
                         COMMON DHIRMITHTAN RC. BBMI. CLIND. THIND. ZL. DHIND. BLKI. AL. ABI. DPIND
000003
                        1,88C1,88C2,88C3,CLC1,CLC2,CLC3,CLTS,THC1,THC2,THC3,THTS,CLRS,THRS,
000004
                        2CLIMP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL3, SOL4, SOL5, SOLIP, SOL
000005
                        3TG-0H2-DH3-DH4-DH5-DH1MP-DHTOT-RP2-RP3-RP4-SM-Q1-SIG-DR-CM2-SCL
900006
                         COMMON DT1, EPS, D2, B2, B3T1, BB2, Z, Z0, Z1, Z2, Z3, Z4, NZ, K3MID, XSI, DPIMP
000007
                         COMMON WP.XN,RHO,OKI,HNPSH,HTOT,PHIMN,VHKM,ETAHI,PSITH,ESHR,RWR
000003
                         COMMON XKPH1, PH121, PH122, PH123, CM1, UT1, PH11T, S, XNS, PS10, PH12, NCASE
000009
                         COMMON F_AG. VIS. FLACO. NWR. U2. PSIRL, OPIPS, PSIIP, PSIIN, FRD
300010
                         COMMON B4.RL.REX.R4.BETA.BFL4.ZD.DINLT.DISTH.TIN.TOUT.XL.V5.
000011
                        IRADUS (95), THETA, RADTH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN,
300012
                        2 ANYAN, BKB, DIFBC, RDIS, ADIS, THICK, THICO, STANG, TRACO, SOLID, BBM4,
000013
                        388M5, FEE, ACROS, AEW, ABS1, DH, AR, ATHT , RI, NOG), NSKIP, OPTFI, PRINT, FI2
000014
                         COMMON RIOPT, RIBM, RIBL, RIBH, DEL, BFL5, DEQ, RMTH, OMPR, OMEW, OMOV
000015
                                                 XKDVD, XK1VD, XKFVD, EVO, FLA, XKQD, O, OD, OMTOT
0000016
                         COMMON V4+M+
309017
                         COMMON RPHG.SSTHG.ESTHG.XKSES.XKMSC.DG.D7.C7.DPSSC.DPSES.DPSMC.C34
                         COMMON REBET. REZD. SBETA. SZD. PSHSG. ETAOV. LOOP. FLAHG. B9
000013
                         COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5
0000019
                     500 FORMAT('1',53X,'DIFFUSER GEOMETRY'///)
000020
                     100 FORMAT(36X, BETA , 9X, ZD , 8X, RSASE , 7X, DINLT , 7X, DISTH , 8X, B4!
000021
                        1/)
000022
                     101 FORMAT(28X+6F12.3//)
000023
                     103 FORMAT (54X, +LOG SPIRAL DATA +///40X, +THETA +, 30X, +RADIUS +/40X, + (DEG)
900124
060025
                        1+,31X,*(IN)*/)
000026
                     501 FORMAT (39X+F6.2+30X+F6.3)
                     502 FORMAT (///54X. *BLADE GEOMETRY *///10X. *DELTA *.6X. *GAMMA *.7X. *ARO *.
000027
                        1 7X, ANVAN', 6X, ADIS', 8X, RAR', 8X, RLOC', 6X, CVAN', 3X, BKB'/
000028
                        2 10X, (DEG) , 6X, (DEG) , 6X, (DEG) , 5X, (DEG) , 6X, (DEG) , 6X,
000029
                        3 *(IN)*,8X,*(IN)*,6X,*(IN)*,7X,*(IN)*/)
000030
                     503 FORMAT(4X,5F11.2,3F11.3,F12.3//)
6000031
                     504 FORMAT(10X, DIFUC', 6X, RDIS', 7X, THICK', 6X, T/C',
0000332
                        1 9X, TINT, 7X, TOUTT, 8X, TXLT, 8X, TDLDMT, 6X, T3CM5 + 6X, TEX51/
000033
                        1 10x, *(IN) *, 7X, *(IN) *, 7X, *(IN) *, 7X, *RATIO*, 6X,
~90J934
                        3 *(IN)*,7X,**(IN)*,7X,**(IN)*,7X,**(IN)*,6X,**(DEG)*,5X,**(IN)*/)
000035
                     505 FORMAT(4X.3F11.3.F11.4.5F11.3.F9.3///)
000936
                     506 FORMAT(50X, TRANSFORMED BLADE DATA 1//)
~00et37
                     507 FORMAT (8X, *STANG*, 14X, *TRACO*, 16X, *SOLID*, 15X, *BBM4*, 16X, *BBM5*,
000038
                        116X, *FEE * /8X, * (DEG) *, 15X, * (IN) *, 36X, * (DEG) *, 15X, * (DEG) *, 14X, ____
000039
                        2 (056)1/)
300040
                     508 FORMAT (6X+F7.3+5F20.3///)
000041
                     509 FORMAT(58X+*AREAS*///8X+*ACROS*+16X+!AEW*+16X+!ABS1!+17X+*AR*+
000042
000093
                        1 18X, DH+, 17X, ATHT+/7X, (SQ IN)+, 13X, (SQ IN)+, 13X, (SQ IN)+,
                        2 34X, (IN) ', 14X, (SQ IN) '/) .
000004
000045
                     510 FORMAT(3X,F10.3,5F20.3)
000046
                         WRITE(3,500)
                         WRITE(3,100)
000047
                         WRITE(3,101) BETA, ZD, R4, DINLT, DISTH, B4
000048
000049
                         WRITE(3,103)
                         L=N-1
000050
                                                                    . .
                         DO 10 J=5,L,5
000051
000052
                         XXXX=FLOAT(J)
                      10 WRITE(3,501)XXXX,RADUS(J)
000053
000054
                         WRITE(3.501)THETA.RADTH
000055
                         WRITE (3,501) ALPHA, RAD
```

DATE 28 APR 72 PAGE 38 @ 654.8.420050,1.100 WRITE (3,503) DELTA, GAMMA, ARO, ANVAN, ADIS, RAR, RLOC, CVAN, BKB 000057 WRITE (3,504) 0.00058 WRITE(3,505)DIFBC, RDIS, THICK, THICO, TIN, TOUT, XL, DLDM, BCM5, TEX5 000059 and the same of the WRITE (3,506) 000060 WRITE (3,507) 000061 WRITE (3,508) STANG, TRACO, SOLID, BBM4, BBM5, FEE . 000062 WRITE (3,509) 000063 WRITE (3,510) ACROS, AEW, ABS1, AR, DH, ATHT [000064] RETURN 900065 END 000066

	1	013V = 2*17*2 *D3*83	990000 990000
		RHRV=DHRVZ.	The state of the s
	ar	DHΩY = 2.*A9 * 89/(A9+B9)	
		Z8 * SI*I = 68	220000
		IF(89) 27.27.28	
		080.0 - 6VAT = 6A	TS0000
		RSV=DSV/2.	000000
•		R9=D9/S•	6%0000
		VAS\ 00*1416*09	
•		$\bullet I - GZ = VAZ$	
	•	IE(Z8A) 52.52.56	
		eo 10 56	. 00000
		$\Delta z = v A z$	T9 ##0000
	•	IE(ELAHG-7.) 80,80,81	£40000
		D2A=D3*BD2A	0000045
	•	$BOZA = T^{\bullet}T$	0000ti
ř.		IE(KD2A) 52:52:5#	00000t0 SS
		Da = D11	
k.		IE(DA) SI'SI'SS	000000
	•	R8=08/2.	
<u> </u>	·	RMUT= R6RM*(B6+87)/2.	
	e e	BBSW = I'f	
		IE(RBRM) 10,10,17	
		IE(B0BM) 10-10-15 CW0 = C0+2IN(BCW2K)	
		ECW2R = ALP6/57296	
			= :
		09 01 09	
	and the second second second	CWe= Ce * SIN(ALPGR)	
		IF (FLAHG-7.) 48.48.49	
	•	08 = 2.**DIF8C	
		7 = 96/RB67	
	•	1.1 = 7888	
		IF(RS67) 10.10.12	0000052
* ,		ALP6R=ALP6/57•296	
		VLP6 = 90• − 8FL5	
		#8 = 98	
		MIND = Mb*(1*+0KI)	. 000057
	•	Σ=M ⁻¹	000050
- I	•	COWMON_CERT: EINC'SETO\BBBW\D0'8BBW\D10'SBA'SDA'SDA\BDZX2'DEDW\BCW2	610000
		COWWON BUBET, RLZD, SBEIA, SZD, PSHSG, EIAOV, LOOP, FLANG, 59	000078
:		COWWOR BEHE! ZZIHE! EZIHE! XKZEZ! XKWZC!DQ! CI! DEZC! DEZKC! DEZWC! CZ#	270000
4	· •	COWWOR A**W* XKDAD*XKTAD*XKEAD*EFA* XKOD*G*GD*OWIOI	
		COWNON BIOSI BIEM BIBE BIBH DEF BEFELDEG BULH OWER OWEN	
+ a		BGWS, FEE, ACROS, AEW, ABS1, DH, AR, ATHI , RI, NOGO, NSKIP, OPTF1, PRINITFI2	
•	•	"ANVAN'BKB.DIFBC.RDIS'ADIS'THICK,THICO.STANG.TRACO.SOLID.BBM4.	
	<u> </u>	RADUS (95) + THETA - RADTH + ALPHA - RAD - DELTA - GAWWA - ARO - RAR - REOC - CVAN - MANA - MANA - ARO - RAN	
		COMMON BEFREEN REX REFA BETA BETA BODINLT DISTHATINATOUT XL.C6.	
		COMMON FLAG.VIS.FLACO.WWR.U2.PSIBL.PDFIPS.PSIIP.PSIIN.FRO	
		COWMON XXPH1.PHI21.PHI22.PHI23.CM1.UT1.PHII1.5.XXX.PSIO.PHI2.XXCASE	
	•	COMMON MERKY, EHOPORITHMESH HIOI DEEM NAKW EIGHI PEITH EERBREEM	
		COWWOA DITYERS'OS'RS'BBS'S'SO'SI'SS'KS'SG'KRYKBWID'XZI'DDIWD	
		TO. SHR. DH3. DH4. OH5. DH101. RP2. RP3. RP4. SM. 01. SIG. DR. CM2. SCL	
	•	CLIMP.THIMP.CLTOT.THTOT.8LK2.A2.SOL1.50L2.50L3.SOL4.SOL5.SOL1P.SOL	
		FBECI. BBCS. GLC1. CLC2. CLC3. CLT5. THC1. THC2. THC3. THT5. CLR5. THRS.	
		COMMON DHIERALHERARCEBRICCIND. THIND. ZL. DHIND. BLKI. A1. ABI. DPIND	500040
	•	COMMON XX(8)+XX(8)+XK(8)	
•	\$	SD3R00TINE_REVCH	000007
* 21 touther			

00141466545454415446

DVIE SU VEN TO PAGE

	UP 10 10 14 12 10 10 10 10 10 10 10 10 10 10 10 10 10
g 000057	CM10 :: 0.321 * 00/AE10
્રે 000058 -	BEIOR = BEIO/57.296
養 000059	IF(BE10-90.) 15,18,15
000000	18 C10 = CM10 ,
000061	GO TO 19
§ 000052	15 C10 = CM10/SIN(BE10R)
000053	19 IF(FLAHG-7.) 200,200,202
000064	200 CU6= C6 ★ COS(ALP6R)
\$\ 000065	CM7 = RB67*CM6
000055	CU7 = CM6*86/(0.785*CLUT*RMUT+86 *SIN(ALP6R)/COS(ALP6R))
000067	ALP7R=: ATAN(CM7/CU7)
000068	ALP7= 57.296 * ALP7R
§ 000069	C7 = SGRT(CU7**2+CM7**2)
003070	HLUT= 0.01554*(CU6**2-CU7**2)
000071	TRVT= 3-1416 * D8/ZRV
000072	IF(THRV) 30,30,31
000073	30 THRV = 0.120
000074	31 BETBR=ATAN(FINC*TRVT/(TRVT-THRV)*SIN(ALP7F)/COS(ALP7R)).
000075	EET8= 57.296*BET8R
009675,	BLA=(D8*SIN(BET8R)+ DSV)/(D8*COS(RET8R))
000077	BLB=(D8*COS(BETER))/(D8*SIN(BET8R)+DSV)
000078	XLAG = 2. ((BLA-PLB)
000079	IF(XLAG) 60,61,61
000080	60 BLAGR = 3.1417 -ATAN(ABS(XLAG))
000081	GO TO 63
000008	61 HLAGR=ATAN(XLAG)
000033	63 BLAG=57.296 *BLAGR
000034	PBLU= (RB**2- RSV**2)/(2.* R8*COS(BET8R))
000085	BLRV= BBLD * BLAGR + RSV -R9 .
000086	DMRV = SORT((D8**2+D9**2)/2.)
000087	TMRV = 3.1416/ZRV*DMRV
1 000000	SOURV= BLRVZTMRV
d: 000089	C710 = SQRT(0.5*(C10**2+C7**2))
000090	GO TO 190
000091	202 DHDEX = 2.*86*ADEX5/(86+ADEX5)
000092	DHRV = 0.5*(DMDEX+DHRV)
000093	PHRV = 0.5*DHRV
7000094	FLUTM = 3.1416*RMUT
000095	FLRCM = R0=R0
000096	FLCM=FLUTM+FLRCM
000097	BST7 = BCM5 + (90 BCM5)*FLUTM/FLCM
000098	BE67R= 0.5*(BCM5+BET7)/57.296
000099	FLUT = FLUTM/SIN(BE67R)
000100	BE79R = 0.5*(BET7+BE10)/57.296
000101	FLRC = FLRCM/SIN(BE79R)
000102	FLC = FLUT + FLRC
000102	BLRV = FLC
000104	C710 = SCRT(0.5*(C6**2+C10**2))
000104	AEC6=ADEX5*86
/	AEC8=A9*39
000106	0MDRV =((1AEC6/AEC9)**2+0.2*(1(AEC6/AEC9)**2))/2.
000107	CLUT = 0.28-0.15*SQRT(2.*RMUT/(B6+B7)-1.)
000108	
000109	HLUT = CM6**2/64.348*2.*CLUT
000110	190 RERV=DHRV*C710*RHO/(386.088*VIS)
000111	IF (RERV-1.E+05) 520.520.525
000112	520 FRC = 0.0032+0.221/RERV**0.237
000113	60 TO 530 525 FRC = 1./(0.86858*ALOG(RHRV/XKFVD)+ 1.74)**2
000114	525 FRC = 1.7(0.86858*ALOG(RRXV) ARTVO/T 1.747**2 530 PLFRV = FRC*C710**2/64.348*BLRV/OHRV
000115	IF(FLAHG=7.) 220,220,222
000116	TEACHMOTION SERVENIES

```
DATE 28 APR 72 PAGE
                  DIGURER + 4 28350 + 1 + 100
                    222 HLDRV=OMDRV*C6**2/64.348
000117
                       HLRC = HLFRV + HLDRV + HLUT
000118
000119
                       PSIUT=32.174*HLUT/U2**2
                       PSDRV= 32.174*HLDRV/U2**2
000120
000121
                       PSFRV = 32.174*HLFRV/U2**2
000122
                       PSIRC = PSIUT + PSDRV + PSFRV
                       IF(PRINT) 72,72,730
000123
                   730 WRITE(LW,9)
000124
000125
                       WRITE (LW.604)
                       WRITE(LW.701) RMUT.B7
000126
000127
                       WRITE(LW,707) FLC,89
000128
                       WRITE(LW.709) DHRV.D9
000129
                       WRITE(LW, 606)
200130
                       WRITE(LW, 711) CM6, C10
                       WRITE(LW.715) RERV
000131
000132
                       WRITE (LW, 607)
000133
                       WRITE (LW, 717) FRC
000134
                       WRITE(LW:719) HLUT:PSIUT
000135
                       WRITE(LW,721) HLDRV,PSDRV
000136
                       WRITE(LW,723) HLFRV,PSFRV
                       WRITE(LW,727) HLRC, PSIRC
000137
                     9 FORMAT (45X . 'REVERSING CHANNEL WITH CONTINUOUS VANE'/)
000138
                    604 FORMAT (55X, GEOMETRY!/)
000139
                   606 FORMAT(45X, FLUID ANGLES AND VELOCITIES !/)
000140
                    607 FORMAT(53X, PERFORMANCE!/)
000141
                    701 FORMAT(1X, MEAN TURNING RADIUS, U-TURN, RMUT, 2X, F10.3, 2X, IN,
000142
                      112X, *CHANNEL HEIGHT 87*, 20X, F10.3, *IN*)
000143
000144
                    707 FORMAT(1X, *APPROX. CHANNEL LENGTH, FLC*, 8X, F10.3, 2X, *IN*,
000145
                      112X, CHANNEL HEIGHT B91, 20X, F10, 3, 1N1)
000146
                    709 FORMAT(1X, 'HYDRAULIC DIA, CHANNEL, DHRV',
                                                                       7X+F10.3+2X+'IN'+
000147
                      112X, MEAN EXIT DIA, D91,20X,F10.3,2X, IN1//)
000148
                    711 FORMAT(1X, MERIDIONAL VELOCITY, CM6', 11X, 10.3,2X, FT/5', 10X,
000149
                      1+ABSOLUT VELOCITY, VANE EXIT, C10+,6X,F10.3,2X,+FT/S+)
                    715 FORMAT(1X. TREYNOLDS NO, MEAN, RERVT, 12X, E10.4, 2X, *****//)
000150
                    717 FORMAT(1X, FRICTION COEFFICIENT, FRC , 10X, F10.5, 2X, *****)
090151
                    719 FORMAT(1X, *HEAD LOSS, U-TURN, HLUT*, 12X, F10, 3, 2X, *FT*, 12X,
000152
                      1 HEAD LOSS COEFF, U-TURN, PSIUT , 8X,F10.4,2X, ****!)
000153
000154
                    721 FORMAT(1X, HEAD LOSS DIFFUSION, HLDRY 1, 9X, F10.3, 2X, FT1, 12X,
000155
                      1 HEAD LOSS COEFF, DIFFUSION, PSDRV', 5X, F10, 4, 2X, ****)
000156
                    723 FORMAT(1x, HEAD LOSS FRICTION, HLFRV', 10X, F10, 3, 2X, FT1, 12X
                      000157
                    727 FORMAT(1X, 'HEAD LOSS, REVERSING SYSTEM, HLRC', 3X, F10, 3, 2X, 'FT', 12X,
000158
                      1. HEAD LOSS COEFF, REVERSING SYST, PSIRC1:510.4.2X.14**1///
000159
                       GO TO 72
000160
000161
                    220 DRV=1.-C10/C7 + D8 * CU7/(SOLRV*C7*(D8+D9))
000162
                       OMDRV = XKDVD * DRV**EVD
000163
                       HLDRV=0MDRV*C7**2/64.348
                       HLINV=(CM7*(COS(ALP7R)/SIN(ALP7R)-COS(BET3R)/SIN(BET8R)))**2/64.34
000164
000165
                       18
000166
                       HLRY=HLDRY + HLFRY + HLINY
000167
                       HLRC = HLRV + HLUT
000168
                       PSINV = 32.174*HLINV/U2**2
000169
                       PSIUT=32.174*HLUT/U2**2
                       PSIRV=32.174*HLRV/U2**2
000170
                        PSIRC=PSIUT+PSIRV
000171
                       PSDRV= 32.174*HLDRV/U2**2
000172
                       PSFRV = 32.174*HLFRV/U2**2
000173
000174
                        IF(PRINT) 72,72,330
000175
                    330 WRITE(LW.1)
000176
                       WRITE (LW+4)
```

Minneson.

000177	WRITE (LW+301) RMUT+37	<u> </u>
090178	WPITE (LW, 303) BET8, BLAG	
000179	WRITE(LW, 305) DSV-RBLD	
000180	WRITE(LW,307) BLRV,SOLRV	
181000	WRITE(LW.309) DHRV.ZRV	
000132	WRITE(LW.6)	
000183	WRITE(LW,311) CM6,C7	
000184	WRITE(LW.313) ALP7.010	
000185	WRITE(LW, 315) RERV	
000186	WRITE(LW.7)	
090187	WRITE(LW,317) DRV,FRC	•
000183	WRITE(LW.319) HLUT, PSIUT	
000189	WRITE(LW,329) HLINV,PSINV	
000190	WRITE(LW,321) HLDRV,PSDRV	-
000191	WRITE(LW, 323) HLERV, PSERV	
000192	WRITE(LW,325) HERV,PSIRV	
000193	WRITENLW, 327) HLRC, PSIRC	
000194	1 FORMAT(40X) PEVERSING CHANNEL WITH VANELESS U-TURN'/)	
000195	4 FORMAT(55X, GEOMETRY'/)	
000196 ,	6 FORMAT(45X**FLUID ANGLES AND VELOCITIES*/)	
000197	7 FORMAT (53X + PERFORMANCE 1/)	
000198	301 FORMAT(1X, MEAN TURNING RADIUS, U-TURN, EMUT', 2X, F10.3, 2X, 'IN', 12X	
000199	1. INLET VANE HEIGHT, B7',17X,F10.3,2X,'IN')	
000200	303 FORMAT(1X, VANE INLET ANGLE, BET8', 13X, F10.3, 2X, DEG', 11X,	
000201	1 'VANE TURNING ANGLE, BLAG',14X,F10.3.2X,'DEG')	
000202	305 FORMAT(1X, DIAMETER DSV', 23X, F10.3, 2X, JN', 12X,	
000203	1 *VANE TURNING RADIUS, RBLD*,13X,F10.3,2X,*'IN*)	
000204	307 FORMAT(1X, 'VANE LENGTH, BLRV' 18X,F10.3,2X, IN', 12X,	
000205	1 'VANE SOLIDITY, SOLRV',18X,F10.3,2X,'***')	
000206	309 FORMAT(1X, "HYDRAULIC DIA, VANE PASSAGE, DHRV", 2X, F10.3, 2X, "IN",	
000207	112X,*VANE NUMBER, ZRV**20X,F10.3,2X,****//)	
868600	311 FORMAT(1X, MERIDIONAL VELOCITY, CM6', 11X, F10, 3, 2X, FT/5', 10X,	
000209	1 *ABSOLUT VELOCITY: VANE INLET: C7*:6X:F10.3:2X:*FT/S*)	
000210	313 FORMAT (1X, FLUID ANGLE VANE INLET, ALP7', 7X, F10.3, 2X, FT/S', 10X,	
000211	1'ADSOLUT VELOCITY, VANE EXIT, C10',6X;F10.3,2X;'FT/5')	
000212	315 FORMAT(1X, 'REYNOLDS NO, MEAN, RERV', 12X, E10, 4, 2X, '***'//)	
000213	317 FORMAT(1X, DIFFUSION PARAMETER VANE, DRV1,6X,F10,4,2X, ****,11X,	
990214	1.FRICTION COEFFICIENT VANE, FRC., RX.FIO.5,2X., ****)	
000215	319 FORMAT(1X, "HEAD LOSS, U-TURN, HLUT", 12X, F10.3, 2X, "FT", 12X,	
000216	1. HEAD LOSS COEFF, U-TURN, PSIUT., 8X, F10.4.2X, ****)	
000217	321 FORMAT(1X, 'HEAD LOSS DIFFUSION, HLDRV', 9X, F10.3, 2X, FT', 12X,	
000218	1.HEAD LOSS COEFF, DIFFUSION, PSDRV',5X,F10.4,2X,'****)	
000219	323 FORMAT(1X, "HEAD LOSS FRICTION, HLFRV", 10x, F10, 3, 2X, "FT", 12X,	
000220	I'HEAD LOSS COEFF, FRICTION, PSFRV',6X,F10.4,2X, *****)	
000221	325 FORMAT(1X, HEAD LOSS, VANE, HLRV:,14X,F16.3,2X, FT1:,12X,	
000355	1'HEAD LOSS COEFF, VANE, PSIRV', 10X, F10.4,2X, ****)	
000223	327 FORMAT(1X. 'HEAD LOSS, REVERSING SYSTEM.HLRC', 3X.F10.3.2X, 'FT', 12X,	_
J00224	1'HEAD LOSS COEFF, REVERSING SYST, PSIRC', F10.4, 2X, '***'/)	
000225	329 FORMAT(1X, HEAD LOSS, INCIDENCE, HLINV: 6X, F10.3, 2X, FT: 12X,	
6588000	1.HEAD LOSS COEFF, INCIDENCE, PSINV',5X,F10,4,2X,'***')	
000227	72 HLVD=0MT0T*V4**2/64.35	
000228	PSIVD=HLVD*32.174/U2**2	
000229	PSHSG=PSIVD+PSIRC	
000230	PSIOV=PSIIP-PSHSG	
000231	HTOTF=PS10V*U2***2/32.174	
000232	ETANIEPSIOV/PSITH	
000232	ETAOV=PSIOV/PSIIN*WP/WIMP	
000234	M = M+1 E 140A-E210A\(\text{L211} \text{MEAMLAMIME}	
	IF (PRINT) 800,800,750	
000235	TEVENTAL OCCUPONALOC	

```
chattings see you store in a s
                                              WRITE 3.29) PSHSG
                                             WPITE(3,37) ETAMI
WRITE(3,39) ETAOV
5- 0233
000239
                                             WRITE (3,41) PSIOV WRITE (3,441) HTOTE
499863
600241
                                     WRITE 3,441) HTOTE

47 FORMA" (5X,*HEAD LOSS COEFF, DIFFUSER, PSIVD*,8X,F10.4,3X,*****)

41 FORMA" (5X,*PUMP OVERALL HEAD COEFF, PSIOV*,9X,F10.4,3X,*****)

29 FORMAT(5X,*HEAD LOSS COEFF, HOUSING, PSHSG*,9X,F10.4,3X,*****)

39 FORMAT(5X,*EFFICIENCY, OVERALL, ETAOV*,14X,F10.4,2X,*****)

441 FORMAT(5X,*TOTAL HEAD PISE, HTOTF*,18X,F10.3,2X,*FT*)
009242
000243
0:0254
000205
Öt 9296
                                        37 FORMAT(5x, 'EFFICIENCY, HYDRAULIC, ETAHI', 12x, F10, 4, 2x, ****)
000247
                                      800 RETURN
000248
                                   END _
000249
```

```
₩ ELT SAFE, 1,710427, €3125
                         SUBROUTINE SAFE
"100001"
                                   XK(8), XZ(8), XFR(8), XR(8)
000902
                         COMMON DHI+RMI+H+RA+RC+BBMI+CLIND+THIND+ZL+DHIND+BLK1+A1+AB1+DPIND
000003
                        1,88C1,88C2,88C3,CLC1,CLC2,CLC3,CLT5,THC1,THC2,THC3,THT5,CLR5,THRS,
C000004
                        2CLIMP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL3, SOL4, SOL5, SOLIP, SOL
000005
                        3TO.DH2.DH3.DH4.DH5.DHIMP.DHTOT.RP2.RP3.RP4.SM.QI.SIG.DR.CM2.SCL
000006
                         COMMON DT1.EPS.D2.82.88T1.882.Z.Z0.Z1.Z2.Z3.Z4.NZ.K3MID.XSI.DPIMP
~000007
000003
                         COMMON WP.XN.RHO.QKI.HNPSH.HTOT.PHIMN.VHKM.ETAHI.PSITH.ESHR.RWR
000000
                         COMMON XKPH1, PHI21, PHI22, PHI23, CM1, UT1, PHI1T, S, XNS, PSIO, PHI2, NCASE
                         COMMON FLAG, VIS, FLAGO, WWR, UZ, PSIBL, DPIPS, PSIIP, PSIIN, FRD
000010
                         COMMON B4, RL, REX, R4, BETA, BFL4, ZD, DINLT, DISTH, TIN, TOUT, XL, V5,
000011
                        IRADUS(95), THETA, RADTH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN,
000012
                        2ANVAN, BK3, DIFBC, RDIS, ADIS, THICK, THICO, STANG, TRACO, SOLID, BBM4,
000013
                        3PBM5, FEE, ACROS, AEW, ABS1, DH, AR, ATHT , RI, NOGO, NSKIP, OPTFI, PRINT, FI2
000014
000015
                         COMMON RIOPT.RIBM.RIBL.RIBH.DEL.BFL5.DEG.RMTH.OMPR.DMEW.OMOV
                                                 XKDVD, XK1VD, XKFVD, E'/D, FLA, XKQD, Q, QD, OMTOT
000016
                         COMMON V4 M ..
000017
                         COMMON RPHG, SSTHG, ESTHG, XKSFS, XKMSC, D6, D7, C7, DPSSC, DPSFS, DPSMC, C34
000018
                         COMMON RUBET, RUZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, 39
0000019
                         COMMON CLUT, FINC, BEIO, RERM, D9, RB67, THRV, ZRV, RDSV, TEX5 , DLDM, BCM5
                         BB2R=BB2/57.296
000020
                         IF(LOOP) 20,20,25
000021
                     20 PSITH=PSIO-PHI2*COS(BB2R)/SIN(BB2R)
280000
900023
                     25 HTHI=HTOT/ETAHI
0000624
                         U2=SORT(32.174*HTHI/PSITH)
000025
                         D2=229.3*U2/XN
000026
                         R2=D2*0.5
000027
                         BLK2=0.05*Z/(D2*SIN(BB2R))
000028
                         BLK2 = .1 * (1.-BLK2) + BLK2
090939
                         CM2=PHI2*U2
                         AB2=0.321*0I/CM2
000030
                         B2=AB2/(3.14159*D2*(1.-BLK2))
000031
000032
                         IF(PRINT) 50,50,40
000033
                      40 WRITE(3,1) NCASE
                         WRITE(3,3) PSITH
000054
                         WRITE(3,4) HTHI
000035
006036
                         WRITE(3,6) D2
                         WRITE(3,7) BLK2
000037
000038
                         WRITE(3,9) AB2
000039
                         WRITE(3,18) B2
0.00000
                         WRITE(3.8) CM2
000091
                         WRITE(3,5) U2
                         WRITE(3,30) PHI2
000042
                       1 FORMAT( 11 , 5X , 1*** CASE , 12, 1 *** /)
0000043
                       3 FORMAT(5X, THEORETICAL HEAD COEFFICIENT, 12X, F10.4, 4X, *****)
000044
                       4 FORMAT(5X, THEORETICAL HEAD , 24X, F10.4, 4X, FTT)
000045
                       5 FORMAT(5X, IMPELLER TANGENTIAL VELOCITY', (2X, F10.4, 4X, FT/SEC')
000046
                       6 FORMAT(5X, 'IMPELLER DISCHARGE DIAMETER', 13X, F10.4, 4X, 'INCH')
000047
                       7 FORMAT(5X, *IMPELLER DISCHARGE BLOCKAGE*, 13X, F10.4, 5X, *****)
900048
                       8 FORMAT(5x, IMPELLER MERIDIONAL VELOCITY, 12x, F10.4, 4x, FT/SEC)
000049
                       9 FORMAT(5X, IMPELLER DISCH BLCKD AREA 1, 15X, F10.4, 4X, 'SQ IN')
000050
                      18 FORMAT(5X, 'IMPELLER DISCH VANE HEIGHT', 14X, F10,4,4X, 'INCH')
000051
                      30 FORMAT(5X, IMPELLER DISCH FLOW COFFFICIENT , 9X, F10.4, 5X, *****,/)
0000052
000053
                      50 PETURN
000054
                         END
```

DATE 28 APR 72 PASE G ELT SCRLL, 1,710427, 63128 SUBROUTINE SCREL DIMENSION X(10),Y(10),W(10),A(11),B(11) --- eccoci COW /CH DH1+RM1+H+RA+RC+BBM1+CLIND+THIND+ZL+DHIND+BLX1+A1+AB1+DPIND 200002 1,88c1,88c2,08c3,cLC1,CLC2,CLC3,CLTS,THC1,THC2,THC3,THTS,CLRS,THRS, 600003 2CLIVP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL3, SOL4, SOL5, SOLIP, SOL 506004 3TO + DH2 + DH3 + DH4 + DH5 + DH1 MP + DHTOT + RP2 + RP3 + RP4 + SM + Q1 + S1g + DR + CM2 + SCL g00005 COMMON DT1.EPS.D2.B2.BBT1.BB2.Z.Z0.Z1.Z2.Z3.Z4.NZ.KBMID.XSI.DPIMP 000006 COMMON WP.XN.RHO.GKI.HNPSH.HTOT.PHIMN.VHKM.ETAHI.PSITH.ESHR.RWR —— <u>0</u>00007 COMMON X (PHI, PHI21, PHI22, PHI23, CM1, UT1, PHI1T, 5, XNS, PSI0, PHI2, NCASE 000008 COMMON FLAG, VIS, FLACO, WWR, U2, PSIBL, DPIPS, PSIIP, PSIIN, FRD 000009 COMMON B4.RL.REX.R4.BETA.BFL4.ZD.DINLT.DISTH.TIN.TOJT.XL.C5. ~ce9010 IRADUS(95) . THETA . RADTH . ALPHA . RAD . DELTA . GAMMA . ARO . RAR . RLOC . CVAN . 000011 2 ANVAN, BKB, RS +RDIS+ADIS+THICK, THICO, STANG, TRACO, SOLID, BBM4, 000012 BBBM5, FEE, ACROS, AEW, ABS1, DH. AB, ATHT .PI, NCGO, NSKIP, OPTFI, PRINT, FI2 000013 COMMON RIOPT, RIBM, RIBL, RIBH, DEL, BFL5, DEQ, RMTH, OMPR, OMEW, OMOV 000014 XKDVD, XK1VD, XKFVD, EVD, FLA, XKQD, Q, QD, QMTOT 000015 COMMON RPHG.SSTHG.FSTHG.XKSFS.XKMSC.DG.D7.C7.DPSSC.DPSFS.DPSMC.C34_ 600016 COMMON REBET, REZD, SBETA, SZD, PSHSG, ETAOV, LOOP, FLAHG, 39 600017 COMMON CLUT, FINC, BE10, RBRM, D9, RB67, THRV, ZRV, RDSV, TEX5 , DLDM, BCM5 630013 000019 000020 X(1)m10. 000021 DO 10 J=2.6 600022 10 X(J)=X(J-1)+5. .000023 Y(1)=1.086 000024 Y(2) = 1.134"aug025 Y(3)=1.18 000026 Y(4)=1.225000027 Y(5)=1.27880060 Y(6)=1.315000029 W(1)=0.77 000030 w(2)=0.691 ---- 000031 W(3) = 0.628000032 W(4)=0.585 000033 w(5)=0.55 000034 w(6)=0.514 CALL CUFIT (3.6.X.Y.A) 000035 CALL CUFIT (3,6,X,W,B) 000036 WIMP=WP*(1.+QKI) 000037 000038 R5=1.1*B2 IF (FLAHG-3.) 2.2.3 000039 ALPER=ATAN (CM2/PSITH/U2) 000040 000041 ALP5R=ALP2R ALPH5=57.296*ALP5R 000042 ັດບຽ043 05=02 CU2TH=PSITH*U2 200044 000045 CUS=CU2TH 000046 GO TO 4 000047 3 ALPH5=90 .- BFL5 000048 DIFBC=R5 0000039 D5=2*DIFBC ALP5R=ALPH5/57.296 200050 000051 CU5=C5*COS(ALP5R) 4 D6D5=SOLVE (ALPH5.A) 000052 000053 06=05+0605 000054 R6=06/2.

000055

CH6=CU5/D6D5

TCS.20S.20S (ATBS2)		977000
E(ACRST-ADVRQ) 100.82.82 E(ACRST-ADVRQ) 100.82.82		911000
SV2=SD4VCKOS	ìΑ	000112
DV10aT/SSTHG*RPHG*FSTHG		
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		111000
V=Db101-c7**2*RH0/9266•		071000 601000
- 101H**サインのH3=101c		807000
);;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;		Z01000
10.82		901000
0.11000		501000
	4 1 8	501000 501000
\$6*T8*T8 (\$HIS\$)		201000
WIMAM*NIIA*MP/WIMP		000705
HIISd/NOISd=IHV		TOTORO
[01E=b2i00*NS**\$/35°174	Н	007000
011Sd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd-42IISd		660000
YATZ=8HA_		860000
2H20=52IAD+Db2E2+Db5XD	id 27	
1705-HLV0*322.174/U2**2		960000
^D=OW101*A#**\6#*35	72 H	960000
ΣΖ ΟΙ (
0=GAY:	11 b	୍ଟେମ୍ପର
SY.IT.IT (.c. YAT2)		860900
SEZ=2S°1Z##DHZEZ\NS##\$		000001
HEXD=DBEXD*NS**S\35°114		060000
F. P.		680000.
		830000
Z=1.58*D7		780000
==.*\$SY(A)TΩ.14159)		930000
IZEZ=DHZEZ+EZEZQ+C1++S\Qq+2Z+XFZC\D1\T+q;q		
· (ZQ+90)*Z\$ T=05:		#80000
:EZO=T.*\(0.86958*\T06(05C\(5.*XK5FS))+T.74)**2		200000 . 200000
(FLANG-2.) 69.69.112) T	. 180000
/ 2E2=(0°12TISE-#02)*E2E2*C*B0*C1 **5*VF00(1°+#0°52\20B1(0°F000*B0*B0*		080000
TCE-(0 26120-702) TECCE-0-4564C2 **3-401-3E76051(0-16664564		620000
86-12-4-105) 205-20-10-10-10-10-10-10-10-10-10-10-10-10-10		870000
\$\$\$q.\$\c\e\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		770000
C=2061((D*+5-T·SI*182**S)\S*)+T·T*B2		, 970000
-T+#t#1#\V\\3.1#\\\\		540000
10 69		11 00000
	(1	570000
ISEZ=(0°12715E-02)*EZEZ*C*E*C*EV.X **5*VF0G(1°+21°\2081(0°1666*Be*C)	10	S70000
'E2=1*\(0*89\$89*VFO@(D2C\(5**XKZE2))+1*\n\)**S	54 9 9	. TZ0000
(4E-1*E+02)		040000
:=D2C*CN@+8HO\(29@*0984NZ)	38 ⁻	690000
C=20K1((D**5-1*51*E2**5)\5*)+1*1*E2		890000
.≈.*SO\$1(A7.5.14159)		<u> </u>
(FL \HG-2-) 63.64.64		990000
. 5−9HΛJ 3= 0HA		90000
(FLAHG-3.) 61.61.62		#90000 #90000
PHA = = YA		590000
804530°*C06*86 \0		. S60000
IT=GYNS:		190000
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		090000
;=CY\5°2		690000 950000
=c2.7 201/4 (VE 1414 8)		290010

DVIE SR VER 12 BAVEE RE

```
DATE 28 APR 72 PAGE
                   Emc48ER,425850,1,100
000117
                    205 NOGO=1.
000118
                        GO TO 200
                    207 IF(LOOP) 209,209,211
000119
                    209 NSKIP#1
000120
                        60 TO 200
000121
000122
                    211 IF (PRINT) 82,82,212
000123
                    212 WRITE(3,214) ...
                    214 FCRMAT(//5X, HOUSING STRUCTURAL LIMIT EXCEEDED IN FINAL ITERATIONS
000124
000125
                       11//1
500126
                     82 M=M+1
                        IF (PRINT) 200,200,210
000127
                    210 STAY=FLAHG
000128
000129
                        IF (FLAMG-3.) 93,93,91
                     91 FLAHG=FLAHG-3.
000130
000131
                     93 IF(FLAHG-2.) 104,105,106
000132
                    104 WRITE(3,94)
                     94 FORMAT(5x, *** SINGLE DISCHARGE - SINGLE TONGUE VOLUTE ****/)
000133
                        GO TO 97
600134
                    105 WRITE (3,95)
000135
                     95 FORMAT (5X, **** DUAL DISCHARGE VOLUTE ****/).
000136
                        GO TO 97
000137
000138
                    106 WRITE(3,96)
                     96 FORMAT(5X: **** DOUBLE VOLUTE ****/)
000139
000140
                     97 FLAHG=STAY
                     15 FORMAT (5x, 'VOLUTE BASE CIRCLE DIAMETER, D6', 9X, F10.3.2X, INCH')
000141
                     19 FORMAT(SX, VOLUTE THROAT DIAMETER, D7', 14X, F10.3, 2X, INCH')
000142
                     17 FORMAT(5X, *VOLUTE THROAT ABSOLUTE VELOCITY, C7', 5X, F10.3, 2X, *FT/SE
000143
                       101)
000144
                     27 FORMAT(5X, HEAD LOSS COEFF, DIFFUSER, PSIVD', 8X, F10, 4, 3X, ****)
000145
                     29 FORMAT(5X, "HEAD LOSS COEFF, HOUSING, PSHSG", 9X, F10.4, 3X, *****/)
000146
                     31 FORMAT(5X+*PUMP OVERALL HEAD COEFF, PSIOV*+9X+F10+4+3X+*****)
000147
                     33 FORMAT(5X, VOLUTE PRESSURE, PM', 21X, F10.4, 3X, PSI')
000148
                     35 FORMAT(SX, 'REQ. TOT. BLADE AREA, ADVRQ', 13X, F10.4, 3X, 'SQIN'/)
000149
                     37 FORMAT(5X, 'EFFICIENCY, HYDRAULIC, ETAHI', 12X, F10.4, 2X, ****)
000150
                     39 FORMAT(5X, 'EFFICIENCY, OVERALL, ETAOV', 14X, F10.4, 2X, ****)
000151
                     41 FORMAT(5X, 'HEAD LOSS COEFF, EXIT DIFF, DPEXD', 7X, F19.4, 3X, *****)
000152
                    441 FORMAT(5X, TOTAL HEAD RISE, HTOTF', 18X, F10, 3, 2X, FT')
009153
                     43 FORMAT(5X, MAX EXIT DIAMETER, D8, 19X, F10, 4, 3X, IN)
000154
                     45 FORMAT(5X, MAX EXIT DIFFUSER LENGTH, EXDL*, 10X, F10.4, 3X, *IN*/)
000155
                     47 FORMAT(5X, MIN EXIT VELOCITY, C81, 19X, F10.4, 3X, 1FT/SEC1)
000156
                     48 FORMAT(5X, REYNOLDS NUMBER, VOLUTE, RE1, 13X, E10.4, 3X, *****)
000157
                     49 FORMAT(5X, *FRICTION COEFFICIENT VOLUTE, FSFS*, 7X, F10, 4, 3X, *****)
000158
                     50 FORMAT(5X, VOLUTE HEAD LOSS, DHSES! 17X, F10.3, 3X, 'FT')..
000159
000160
                     51 FORMAT(5X, EXIT DIFF HEAD LOSS, DHEXD', 14X, F10.3, 3X, FT'/)
                     52 FORMAT(5X, THEAD LOSS COEFF, VOLUTE, DPSFS*, 10X, F10.4, 3X, *****)
000161
                        WRITE(3,15) D6
000162
000163
                        WRITE(3,19) D7
000164
                        WRITE(3,43) D8
                        WRITE(3,17) C7
000165
000166
                        WRITE(3,47) C8
                        WRITE(3:45) EXDL
000167
000168
                        WRITE(3,48) RE
                        WRITE(3,49) FSFS
000169
000170
                        WRITE(3,50) DHSFS
000171
                        WRITE(3,51) DHEXD
                        WRITE(3,52) DPSFS
000172
000173
                        WRITE(3,41) DPEXD
                        WRITE(3,27) PSIVD
000174
                        WRITE(3,29) PSHSG
000175
                        WRITE(3:33) PM
000176
```

END 000183 PRUTER 00S 281000 WHITE (3,35) ETAOV WRITE (3,37) ETAOV WRITE (3,37) ETAOV WRITE (3,37) PSIOV WRITE (3,37) PSIOV IBIOGO 087000 641000 871000 441000 2 Only, Cares Midgles DATE 28 AND 72 PAGE 400

```
DATE 28 AFF 72
                                                                                                    PASS
                      JULY #428250:1:100;
      D ELT SIZE1,1,710427, 53131
                                                                                                                              PARTY OF
                         SUBROUTINE SIZE!
000001
                        COMMON
                                  XK(8),XZ(3),XFR(8),XR(8)
000002
                        COMMON DHI+RMI, H+RA+RC+BBMI+CLIND+THIND+ZL+DHIND+BLK1+A1+AB1+DPIND
000003
                       1,88C1,88C2,88C3,CLC1,CLC2,CLC3,CLTS,THC1,THC2,THC3,THTS,CLRS,THRS,
000004
                       2CLIMP, THIMP, CLTOT, THTOT, BLK2, A2, SOL1, SOL2, SOL3, SOL4, SOL5, SOLIP, SOL
000005
                       3TO.DH2.DH3.DH4.DH5.DHIMP.DHTOT.RP2.RP3.RP4.SM.QI.SIG.DR.CM2.SCL
000006
                        COMMON DT1+EPS+D2+B2+B3T1+BB2+Z+Z0+Z1+Z2+Z3+Z4+NZ+K9MID+XSI+DPIMP
000007
                        COMMON WP, XN, RHO, OKI, HNPSH, HTOT, PHIMN, VHKM, ETAHI, PSITH, ESHR, RWR
000008
                        COMMON XKPH1, PH121, PH122, PH123, CM1, UT1, PH11T, S, XNS, PS10, PH12, NCASE
000009
                        COMMON FLAG, VIS, FLACO, WWR, U2, PSIBL, DPIPS, PSIIP, PSIIN, FRD
000010
                        COMMON B4.RL.REX.R4.BETA.BFL4.ZD.DINLT.DISTH.TIN.TOUT.XL.V5.
000011
                        1RADUS (95), THETA, RADTH, ALPHA, RAD, DELTA, GAMMA, ARO, RAR, RLOC, CVAN,
000012
                       PANYAN, BKB, DIFBC, RDIS, ADIS, THICK, THICO, STANG, TRACO, SOLID, BBM4,
000013
                       388MS, FEE, ACROS, AEW, ABS1, DH, AR, ATHT RI, NOSO, NSKIP, OPTFI, PRINT, FI2
000014
                        COMMON RIOPT PRIBM PRIBL PRIBH DEL BFL5 DEQ PRMTH COMPROMEW COMOV
000015
                                                                              XKOD:0:00:0D:0MTQT
000016
                         COMMON V4.Mr
                                                XKDVD, XK1VD, XKFVD, EVD, FLA,
                         COMMON RPHG.SSTHG.FSTHG.XKSFS.XKMSC.D6.D7.C7.DPSSC.DPSFS.DPSMC.C34
000017
                         COMMON RUBET REZD SBETA SZD PSHSG ETAOV LOOP FLAHG B9
000018
                         COMMON CLUT.FINC.BE10.RBRM.D9.RB67.THRV.ZRV.RDSV.TEX5 .DLDM.BCM5
000019
                         0=449.*WP/RHO
000020
000021
                         QI=0*(1.+QKI)
                         WIMP=WP*(1.+OKI)
000022
                         01=01
000023
                         S=XN*SQRT(QI)/HNPSH**0.75
000024
000025
                         SPRM=S/SQRT(1.-EPS**2)
                         PHI1T=3574./SPRM
000026
                     11 DT1::4.54*( QI/((1.-EP5**2)*XN*PHI1T))**0.333
000027
                         A1=0.785397*DT1**2*(1.~EPS**2)
[a(ru028]
000029
                         CM1=0.321*QI/A1
                         VHKI=64.348*HNPSH/CM1**2
000030
                         IF (VHKI-VHKM) 10,15,15
000031
                      10 PHI1T=PHI1T-0.01
000032
                         GO TO 11
000033
                      15 IF (PHILT-PHIMN) 20,25,25
000034
000035
                      20 CM1=SQRT(2.*32.16*HNPSH/VHKM)
000035
                         A1=.321*0I/CM1
                         DT1=SQRT(4.*A1/(3.1416*(1.-EPS**2)))
000037
                      12 UT1=XN*DT1/229.
000038
                         PHIIT=CM1/UT1
000039
                         IF (PHI1T-PHIMN) 13, 25, 25.
500040
                      13 XN=XN-1000.
000091
                         GO TO 12
000042
000043
                      25 BBFL=ATAN(PHI1T)*57.296
                         28T1=1.74*B8FL
200044
000045
                         UT1=CM1/PHI1T
                         XNS=XII*SORT(Q )/HTOT**0.75
000046
                         S0=XN*SQRT(Q)/HNPSH**.75
000047
                         S1=XN*SORT(QI)/HNPSH**.75/SORT(1.-EPS**2)
000048
                         IF(882-18.) 500,301,302
000049
                     301 PHI2=0.0465E-03*XNS+0.040
000050
000051
                         GO TO 320
                     302 IF(BB2-25.) 500,303,312
000052
                     303 PHI2=0.0535E-03*XNS+0.057
 000053
 000054
                         GO TO 320
                     312 IF(BB2-30.) 500,313,304
000055
                     313 PHI2=0.06121E-03*XNS+0.06258
```

000056

```
TTT:217.06121E-03*XKS+0.06258
                   BRUNER, 428250, 1, 100
                                                                                    DATE 28 APR 72 PAGE 50
000057
                         60 TC 320
                    304 IF(BB2-35.) 500,305,306
000058
000059
                     305 PHI2=0.0675E-03*XNS+0.067
000060
                         GO TO 320
000061
                    306 IF(882-45.) 500,307,308
000062
                    307 PH12=0.0795E-03*XNS+0.075 /
000063
                         GQ TQ 320
000064
                    308 IF (BB2-60.) 500,309,310
000055
                    309 PHI2=0.0935E-03*XNS+0.086
000066
                         GO TO 320
300067
                    310 IF (BB2-90.) 500.319.500
000068
                    319 PHI2=0.12E-03*XNS+0.12
000069
                    320 G=(90.-B32)/57.296
000070
                        C=COS(6)
000071
                        A=5.5797*C**2/Z**2-19.233*C**4/Z**3+8.6584*C**4/Z**4*(8.*C**2-1.)
000072
                        PSIU=EXP(-2.*G*SIN(2.*G)/Z)*EXP(A)/((2.*C)**(4.*C**2/Z))
000073
                        FI2=PHI2
000074
                        PHI2=XKPH1*PHI2
000075
                    516 FORMAT(///5X, **** OUTPUT ****,/)
000076
                        WRITE(3,516)
000077
                        WRITE(3,38) XN
000078
                        WRITE(3,39) XNS
000079
                        WRITE(3,37) 50
000080
                        WRITE(3,49) S1
060031
                        WRITE(3,51) WIMP
000082
                        WRITE(3,43) OT
000003
                        WRITE(3,41) BBT1
000084
                        WRITE(3,31) DT1
้อดอังอธิ
                        WRITE(3,32) A1
000086
                        WRITE(3,33) CM1
000087
                        WRITE (3,34) UT1
886010
                        WRITE (3,36) PHIIT
010089
                        WRITE(3,45) F12
000090
                        WRITE(3,47) PHI2
010091
                        WRITE (3,2) PSIO
000092
                      2 FORMAT(5X, 'SHUTOFF HEAD COEFFICIENT', 16X, F8.3, 5X; ****)
000093
                     31 FORMAT(5X, 'IMPELLER INLET DIAMETER', 17X, F8.3, 4X, 'INCHES')
000094
                     32 FORMAT(SX, IMPELLER INLET AREA , 21X, F8.3, 4X, 'SQ IN')
000095
                     33 FORMAT(5X, 'IMPELLER INLET MERIDIONAL VELOCITY', F14.3, 4X, 'FT/SEC')
000096
                     34 FORMAT(5X, IMPLLR INLET THENTL VELOCITY, 12X, F8:3, 4X, FT/SEC)
                     36 FORMAT(5X, 'IMPLLR INLEY FLOW COEFFICIENT', 11X, F8.3, 5X, ****')
000097
                     37 FORMAT(5X, SUCTION SPECIFIC SPEED, SO', 12X, E10.4, 4X, RPM*GPM**0.5/
000098
000099
                       1FT**0.75')
000100
                     38 FORMAT(5X, IMPELLER ROTATIONAL SPEED : 13X, F10.3, 5X, RPM')
030101
                     39 FORMAT(5X, 'SPECIFIC SPEED', 24X, E10.4, 4X, 'RPM*6PM**0.5/FT**0.75')
000102
                     41 FORMAT(5X, 'INLET TIP BLADE ANGLE + 19X, FR. 3, 4X, DEGREES !)
000103
                     43 FORMAT(SX: IMPELLER FLOW RATE: 01:17X:F9.3.4X: GPM!)
000104
                     45 FORMAT(5X, DISCH FLOW COEFF REC, SHROUDED IMP. 1,4X, E9.4,4X, 1****)
000105
                     47 FORMAT(5X, DISCH_FLOW_COEFF, INITIAL, 14X, F9.4, 4X, 1***)
000106
                     49 FORMAT(5X, SUCTION SPECIFIC SPEED, S1', 12X, E10.4, 4X, RPM*GPM**0.5/
000107
                       1FT**0.751)
000108
                     51 FORMAT(5X, 'IMPELLER WEIGHT FLOW, WIMP', 12X, F9.3, 4X, 'LB/SEC')
000109
                        GO TO 600
000110
                    500 NOGO=1
000111
                    600 RETURN
000112
                        END
```

2. AXIAL THRUST BALANCER STABILITY ANALYSIS

COMPUTER PROGRAM AXIAL THRUST BALANCER STABILITY ANALYSIS

I. INTRODUCTION

The dynamic stability of a series-flow self compensating thrust balance system operating with liquid hydrogen is analyzed. Two methods of analysis are presented: The energy method and the root locus method. In addition to stability parameters, the program also prints out balancer capacity, flow rate and orifice pressure drops for any specified balance piston position.

This program was written for the parametric evaluation of the axial thrust balancer design of the NERVA Turbopump described in Reference I.

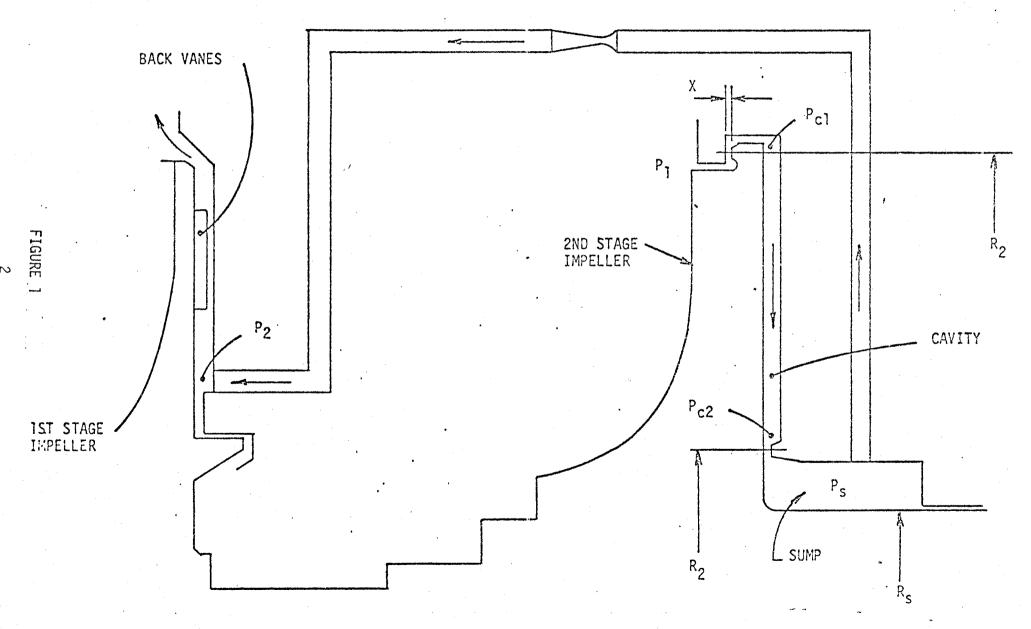
II. DESCRIPTION

The thrust balancer schematically shown in Figure 1 is a double acting series flow balance piston which is integral with the second stage impeller disk. Fluid is bled from the second stage impeller discharge and forced through the high pressure orifice into the balance piston cavity. From the balance piston cavity the fluid passes through the low pressure orifice and discharges into the sump. The sump is vented to the first stage impeller rear cavity through multiple internal flow passages and a common external line which permits installation of venturi flowmeter.

Maximum thrust (towards suction) is achieved with the high pressure orifice closed while minimum thrust is obtained with the low pressure orifice closed.

Reference 1 - Aerojet Nuclear Systems Company Engineering Operations Report N8300R:71-076, NERVA Turbopump Design Report, Volume 1, September 1971.

BALANCE PISTON SCHEMATIC



The balance piston operates between the second stage impeller discharge pressure, P_1 , and the first stage impeller rear cavity pressure, P_2 , (Refer to Figure 1). The effective pressure differential across the balancer face is reduced by the pressure difference, $P_{c1} - P_{c2}$, resulting from fluid rotation in the balance piston cavity. This pressure difference is calculated using the semi-empirical method presented in Reference 1. The angular velocity of the cavity fluid may exceed one half that of the rotor because of the very small axial clearance.

After assuming starting values for fluid density at each orifice the flow rate is calculated from the following equation by an iterative process.

$$\dot{W} = 2g \left[\frac{\frac{P_2 - P_1 - \Delta P_c}{\frac{1}{C_1^2 A_1^2 \rho_1} + \frac{1}{C_2^2 A_2^2 \rho_2} + \frac{1}{C_e^2 \rho_e}} \right]^{\frac{1}{2}}$$

where:

 $A_1 = 2\pi R_1 X$ $A_2 = 2\pi R_2 (\delta - X)$ $\delta = \text{total axial clearance}$ X = high pressure orifice gap $C_1 = \text{high pressure orifice flow coefficient} = .85$ $C_2 = \text{low pressure orifice flow coefficient} = .35$ $C_e = \text{vent line resistancé, calculated} = .5 \text{ Ft}^2$

Using the first approximation of the flow rate the pressure drop through each orifice is calculated. The fluid frictional heating in the cavity is estimated using the friction coefficients based on Schultz-Grunows data presented in Reference 2. The frictional power is calculated as follows:

$$P_{\text{fric}} = .9223 (10^{-8}) \text{ K } \rho \text{ N}^3 (R_2^5 - R_1^5)$$

Pric = disk friction horsepower

K = friction coefficient

 ρ = fluid density (lb/ft³)

N = speed (rpm)

R₂ = outer radius, (inch)

 R_1 = inner radius (inch)

The friction coefficient K is a function of Reynolds number and clearance to diameter ratio. Values of K for smooth and rough disks are published in Reference 2.

The friction loss results in an enthalpy rise

$$\Delta h = \frac{550 \text{ P}_{fric}}{J \text{ W}}$$

and the resulting temperature rise is obtained by dividing Δh by the specific heat $\mathbf{C}_{\mathbf{p}}.$

Assuming an isenthalpic process through all orifices and considering the frictional heat input in the cavity, new values of fluid density are obtained for cavity, sump and exit. These new values are used in place of initial approximate densities and the entire flow calculation is repeated. Two to three iterations are generally required depending on the starting value to achieve consistent values of fluid density.

Reference 1 - Pratt & Whitney Aircraft, Florida Research and Development Center, Investigation of Pressure Prediction Methods for Radial Flow Impellers, PWA-FR-1276, 8 March 1965.

Reference 2 - A. J. Stepanoff, Centrifugal and Axial Flow Pumps, 2nd Edition, J. Wiley & Sons, Inc., New York

Cavity and sump thrust is calculated by numerical integration of the pressure profile, assuming a linear variation of pressure with ${\ensuremath{\text{R}}}^2.$

The dynamic stability analysis is in essence based on the energy method and the root locus method discussed in Reference 3.

III. INSTRUCTIONS

1. The total travel DELT is divided in even increments of 0.001 inch. Present array size limits the effective travel to be analyzed to 0.019 inches, e.g. the maximum value for LIM is 19.

KSTAR permits analysis to start at a higher value of X. To avoid rubbing X will always be larger than 0.001.

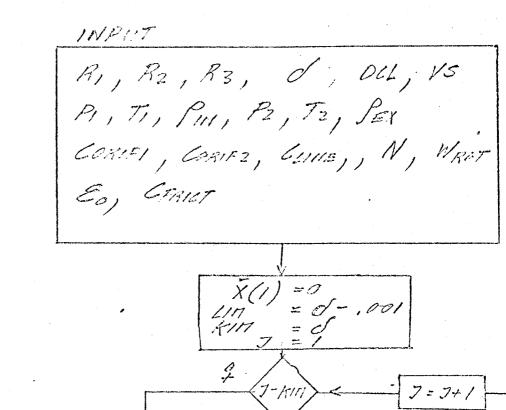
- 2. If NFLAG is negative only the steady state operation of the balancer will be analyzed. If NFLAG is positive the entire analysis will be carried out.
- 3. Orifice coefficients CORF1 and CORF2 based on Rocketdyne data are 0.85.
 - 4. The line loss coefficient between sump and exit is

CLINE = K
$$\frac{\dot{W}}{\sqrt{\Delta P_{\text{line}} \rho_{\text{ex}}}}$$

This coefficient must be estimated from ducting layout.

5. For disc friction coefficients refer to Reference 2. For most applications CFRIC = 0.22×10^{-7} .

Reference 3 - Dynamic Stability Study of a Series Flow Thrust Balance Piston, North American Aviation, Rocketdyne Division, Report R-6809P-1.



Sot up grown for X & CL

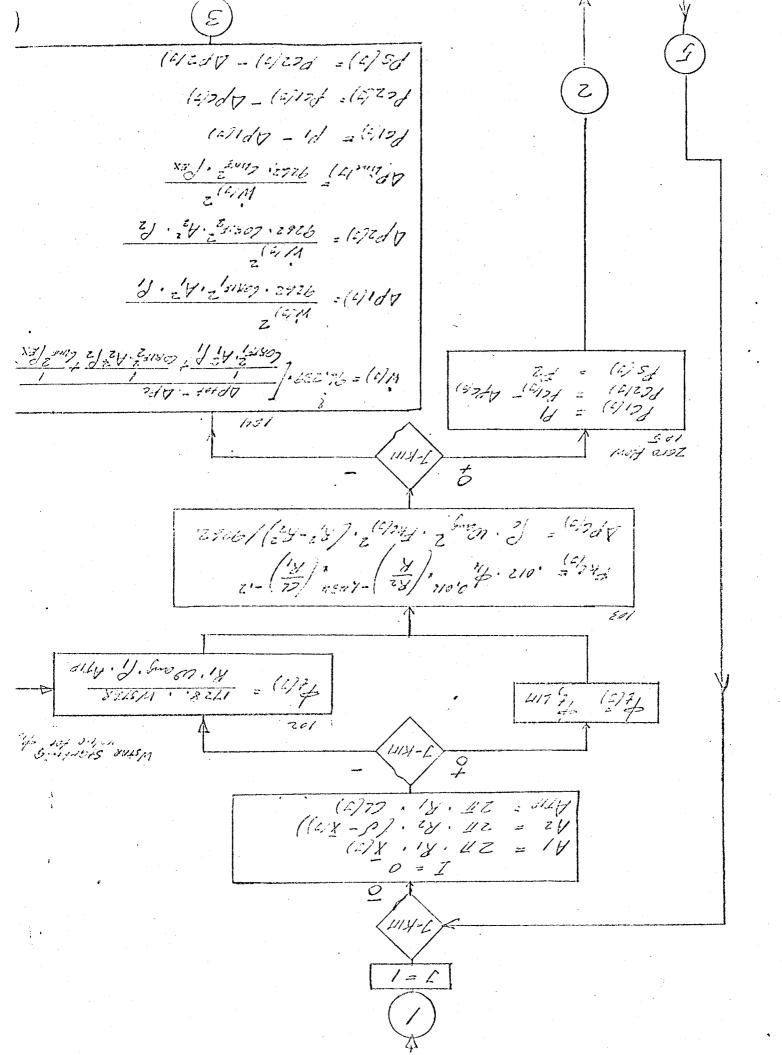
$$\bar{X}(3) = \bar{X}(3) + 0.001$$
 $CL(3) = J - \bar{X}(3) + 0.02$

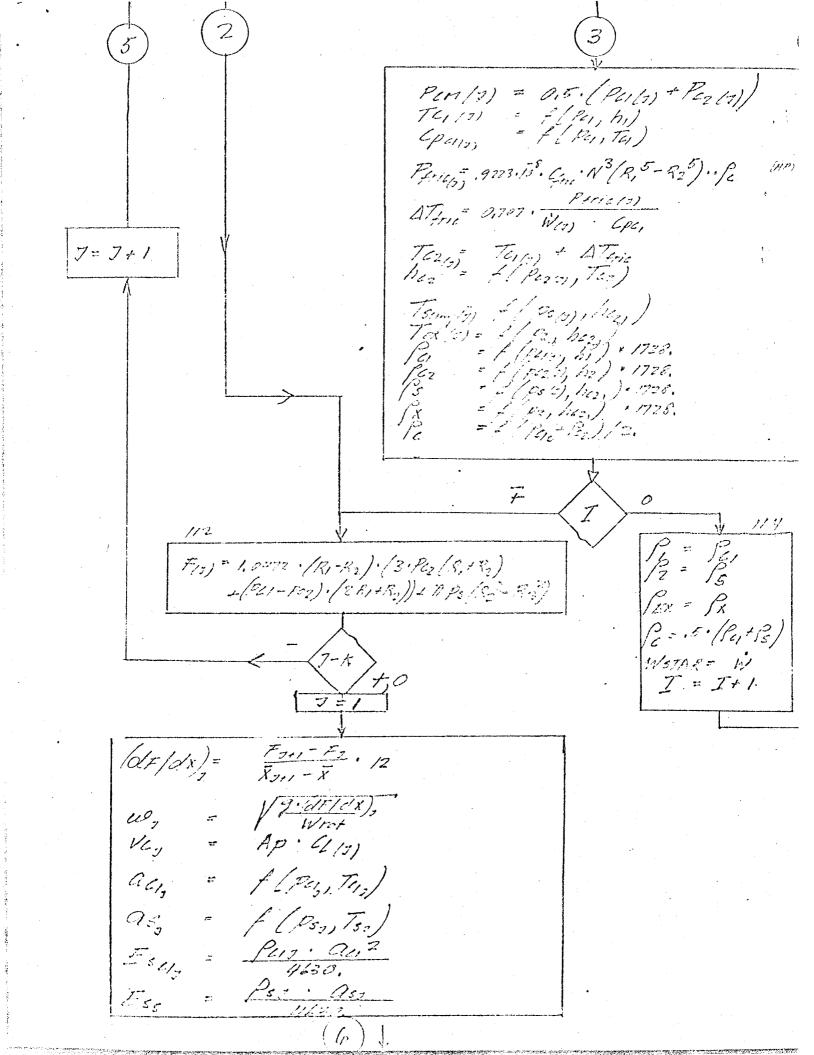
CONSTANTS

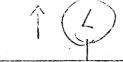
WSTAS = 4.0
Ap =
$$\pi(R_1^2 - R_2^2)$$

As = $\pi(R_2^2 - R_3^2)$
Appet = $P_1 - P_2$
wang = $\pi(R_2 - R_3^2)$

Select Starting Values for density







Erd-627d (2d-15d)/(12d-1d) = ("sol = 27d)/("sd - 1d) = x-9 - 5 -[=(=\frac{51.82(1)}{51.82(1)}+1).(\frac{6.85}{1.85}-\frac{6.85}{1})+\frac{6.887}{1}= [[2(1.25.01)+1) (6128) 6124] + 61283 | 61243 · 3/ - 188/ · 5/ - = fs.// / = 3/1 (224 13d) f a (124) (43) 1 -19-20 = 19+30 = 4.50 750 1750 7191-11191 171-.01 171 (4 (12) / + = 2121 (14 (H126)) = H126 9-6126 = 7126 9-6126 = H126

少个

$$C_{11} = 1 + \Omega$$

$$C_{22} = \int_{C_{11}} A_{p} \cdot \overline{X} / (\dot{w} \cdot 1728)$$

$$C_{33} \cdot A_{c3} + A_{7}$$

$$C_{44} = \frac{\int_{C_{12}} V_{6}}{1728 \dot{y}} \cdot \frac{2(f_{1} - f_{2n})}{E_{2m}}$$

$$C_{59} = |A_{7} \cdot A_{57}|$$

$$C_{7} = \frac{\int_{S_{7}} A_{5} \cdot \overline{X}_{7}}{\dot{w}_{7} \cdot 1728}$$

$$C_{87} \cdot A_{7} \cdot A_{5} + |a_{7}|$$

$$C_{90} = \frac{\int_{S_{7}} V_{6}}{1728 \cdot \dot{w}_{7}} \cdot \frac{2(f_{1} - f_{2n})}{E_{83}}$$

$$C_{197} = |A_{7}|$$

$$A_{7} = \frac{C_{19} \cdot C_{19}}{C_{19} \cdot C_{19}} \cdot \frac{2(f_{1} - f_{2n})}{E_{83}}$$

$$C_{197} = \frac{C_{19} \cdot C_{19}}{C_{19} \cdot C_{19}} \cdot \frac{C_{19} \cdot C_{19}}{C_{19} \cdot C_{19}}$$

$$C_{19} = \frac{C_{21} / C_{197}}{C_{197} \cdot C_{197}}$$

$$C_{19} = \frac{C_{21} \cdot C_{197} + C_{217} \cdot C_{197}}{C_{197} \cdot C_{197}}$$

$$C_{19} = \frac{C_{197} / C_{297}}{C_{197} \cdot C_{197}}$$

$$C_{19} = \frac{C_{197} / C_{297}}{C_{197} \cdot C_{197}}$$

$$C_{197} = \frac{C_{197} / C_{197}}{C_{197} \cdot C_{197}}$$

$$C_{197} = \frac{C_{197} / C_{1$$

$$\frac{301 - 2600}{200 - 2600} = 624$$

(3)

NOMENCLATURE INPUT

SYMBOL.	NOTE	DESCRIPTION	UNIT	FORMAT
R		. Radius High Pressure Orifice	In	F
R ₂		Radius Low Pressure Orifice	In	F.
R ₃		Radius Sump	In	F
DELT		Total Travel	In	F
DCL		Cavity Clearance	In	F
VS		Sump Volume	In ³	F
VOLTP		Tip Cavity Volume	In ³	F
P1		Static Pressure, HP orifice Inlet	psia	F
Tl		Temperature, HP Orifice Inlet	deg R	F
RHOIN		Initial Inlet Density	1b/ft ³	F
P2		Static Pressure, exit	psia	F
ROEX		Initial exit temperature	lb/ft ³	F
LIM	(1)*	Limit of Increments of Travel (19 max)	-	I
KSTAR	(1)*	Starting Value of X	••	I
NFLAG	(2)*	Flag Defining extentof analysis	←	I
00053	(2)4	Outsian Conssision+ UD		F
CORF1	(3)*	Orifice Coefficient HP	, *	F
CORF2	(3)*	Orifice Coefficient LP	•	
CLINE	(4)*	Line Loss Coefficient		F
RPM		Rotational Speed	rpm	F
WROT		Rotor Weight	1b	F
EPS		Ampltidue (∼.001)	In	r
CFRIC	(5)*	Disc Friction Coefficient	•	E

^{*}Refer to Instructions.

21852 LOUM SUZ Udd 3NITT 23800 DELT ASTAR NFLAC XJOY MOHE d1701 SECOENCE IDEMULICATION FORTRAN STATEMENT SISYIANA YTIIIAATZ NOTZIQ ZINALAK MAROOM NONO CARD ELECTRO NUMBER INSTRUCTION**S** A.S.U ni batnii9 IBM mind paibod MARTROT

CX28-7327-6 U/MOF 5

and this most transport published in Addition to 1993 to be a second transport to be a. A.

```
Gesta02 88E
                                                                  COUG
                                                                             0117 TTES00
                           36 017500
                                        0000
                                                                                                         BON SEN ASE
                                                    367 77 PP
                                                                  กอยง
                                                                                            1000
              00000
                                                                             9407 UAIS.00
300 905000
                                                                                                                      0000
                                        0000
                                                                                                        Codsd 67F
                          308 255400
                                                                  0.000
                                                     JEL Chitivu
                                                                                            บับยับ
                                                                              1,19 DS31100
              UUUU
ಪರಿಕ ರಿಗ್ನು 1100
                                                                                                                      0000
                          JUL 9thti00
                                        0000
                                                                                                         HES ELTHOR
                                                                  មេហុក្
                                                     46 199200
                                                                                            TURG
              1000
5144 LE1300
                                                                              9763 187100
                          JUL TUEHUU
                                        0000
                                                                                                         BOS THIRD
                                                                                                                      0000
                                                                  0000
                                                     946 51546A
                                                                                            1000
              1000
                                                                              9073 B02100
9002 120000
                          399 PESUUD
                                        UUUU
                                                                                                                      0000
                                                                                                         _3g_gg9g00
                                                                  OUUU
                                                     388 SC1400
              6000
                                                                                             0000
                                                                                                                                     Ø.
4144 ETASAA
                                                                              HUS LLUTION
                          309 £81400
                                        0000
                                                                                                                       1000
                                                                  0000
                                                                                                        9292 £00100
                                                     Jas Hotting
                                                                                            1000
              1000
9109 629100
                                        0000
                                                                              9214 050100
                          Ourise Sur
                                                                                                                       0000
                                                                                                        4638 960S00
                                                                  TUUU
                                                    001002 0500
               EUUÚ
                                                                                             0000
001280 BUS
                                                                              4965 S20800
                          SUST LETTUG
                                         1000
                                                                                                        3006 347400
                                                                                                                       0000
                                                                  0000
                                                    3855 380200
               1000
                                                                                             0600
                                                                                                                                     0
                                                                              9935 UaTino
51771 TTION
                                         0000
                          BUNE TYRE
                                                                                                                       TOOR
                                                                                                         778 927000
                                                    9055 3371'00
                                                                  0000
               UUUU
                                                                                             0000
BENE SITSOU
                                         0000
                                                                              9095 320F
                                                                                                                       6000
                          4125 F10700
                                                                                                        397C 379#00
                                                    004711 322E
                                                                   0000
               UUUU
1058 BS00
                                                                               THE HUUNOU
                                                                                             1000
                                         0000
                                                                                                                       0000
                          000100 3SUE
                                                                                                         405 759500
                                                    0000 31600
                                                                   กบบบ
               មមម
4965 SSF#
                                                                                             0000
                                                                                                                                     0
                                                                              4002 US9#00
                                         00007
                          Buttot 215E
                                                                                                                       1000
                                                                   0000
                                                                                                        000005 Sepe
                                                    308 443 FOR
               ជបជប
שווג בצחחטט
                                                                                             0000
                                                                              004070 S7F
                          ∃ħ0£ Z₩9ħu0
                                         0000
                                                                                                        602200 55IF
                                                                                                                       TOOD
                                                                   1000
                                                    nandle 2726
3908 S38400
               uuuu
                                                                                             1000
                                                                              002386 283L
                          00#612 209F
                                         0000
                                                                                                         415 050400
                                                                                                                       0000
                                                                   TUUU
                                                    7922 992500
               0000
 3F 202500
                                                                                             1000
                                                                                                                                     0
                                                                              002236 211L
                                         0000
                          _45S 2S0400
                                                                                                                       DOOL
                                                                   TUUU
                                                                                                         PROTECTION
               auuu
                                                     D015 8098.00
                                                                                             bene
 456 9h0h00
                                                                               400 929000
                                         1000
                          003872 215L
                                                                                                                       1000
                                                                                                         00303 189C
                                                                   TUÜU
                                                     1102 212500
               LUUU
                                                                                             0000
 7719 957500
                                                                               901 S10400
                                         1000
                          002251 SUZE
                                                                                                                       1000
                                                                                                         1974 519500
                                                                   1000
                                                     002025 TAUF
               1000
                                                                                             TOUG
                                                                                                                                      C
7502 082800
                                         1000
                                                                               JUST 470500
                                                                                                                       1000
                          71101 9110200
                                                                                                         005212 110F
                                                                   TUUU
                                                     JS81 901500
               LUUU
                                                                                             COOT
 1501 150200
                                                                               002520 172L
                                         TOUU
                                                                                                                       1000
                          JAST TSTSOO
                                                                                                         D01129 186F
                                                                   TUUU
                TOUG
                                                     THAT SHESOU
                                                                               351 d87800
                                                                                             0000
This LEVEUU
                          JAY1 888800
                                         TOUU
                                                                                                                       TOOD
                                                                    1000
                                                                                                        90311 410200
 1071 972900
                1000
                                                    agree Gingbu
                                                                              002020 11010
                                                                                              1000
                                                                                                                                      0
                           751 547500
                                         0000
                                                                                                                       0000
                                                                                                         311 6875UU
                                                                    1000
                UUUU
                                                    UUSIIO ISOSe
                                                                                              0000
 347 877800
                                                                              99011 989300
                          002172 12206
                                          TOOU
                                                                                                           91 CH8500
                                                                                                                       unnu
                                                                    1000
                                                     DELL ENTRA
                LUUU
                                                                                              0000
002506 1235G
                                                                                901 289800
                          002667 11306
                                          TUUU
                                                                    TUUU
                                                     7201 026000
                LUOU
                                                   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)
                                                                                                                                      •
THIL TSTOOM
                                          TOOU
                          Oushal 10216
                1000
नार्या दन्मद्वात
                                                                                                          SHOISN
                                                                                                                   7100
                                                                                                            MIS
                                                                                                                   9100
                                                                                                           MINTA
                                                                                                                   9100
                                                                                                          MEXhea
                                                                                                                   007#
                                                                                                           1965
                                                                                                                   0013
                                                                                                           9.00350
                                                                                                                   0015
                                                                                                           HIGH
                                                                                                         PKOIN
                                                                                                                   TIOU
                                                                                                                   orce
                                                                                                           ผลอสม
                                                                                                          Mnosta
                                                                                                                    2200
                                                                                                          S-170Hd
                                                                                                                    9000
                                                                                                            d01d
                                                                                                                    6000
                                                                                                          उधनामत
                                                                                                                   0000
                                                                                                          H150114
                                                                                          EXTERNAL REFERENCES (BLOCK: MAME)
                                                                                                 #3F¥1£K 0000nn
                                                                                                                    2000
                                                                                                                    0000
                                                                                                           # LV()*
                                                                                                  212500
                                                                                                                    1000
```

4.100 * 564500

PROBLE USED (BLOCK) MARICA LENGTH)

MARCOHY MIAM

C

THIS CONFIDENTIAN WAS COME ON 07 SEP 71 AT 11:15:18 DATANC 1708 FORTRAN V LEVEL 2206 0018 F50165

```
30 FORMAT(3F8,3*F8.1*2F8.4*E8.2)
                                                                                                                                                                                                                                                   TITOO
                                                                                                                                                 26 FORMAT(SF3.3+315)
                                                                                                                                                                                                                                                   OUTTO
                                                                                                                                                                                                                                                   inten
                                                                                                                                                             10 FURNAT(7FS.3)
                                                                                                                                                                                                                               *11
                                                                                                                                                                                                                               *0T
                                                                                                                                                                                                                                                   COTOR
                                                                                                                                                                                 9 = 47
                                                                                                                                                                                 S = N7
                                                                                                                                                                                                                               *GT
                                                                                                                                                                                                                                                   COTOO
                                                                                                                                                                                                                                                   00100
                                              SLEVE(#) + BITTY (50) + XIWW (50) + XWB (50) + SELV (50) + LZEL (50)
     1231(50) 2d(50) 2d1(50) 2d1(50) 2dK(50) 2dK(50) 2dCb0(50) 2d1(50) 1LC2(d)
                                                                                                                                                                                                                                                   #0100
        DIMENSION SRI(20), ART(20), SI(20), SI
                                                                                                                                                                                                                                                   botco
                                                                                                                     PETCH(S9) PRODOM(S0) CHI(SU)
                                                                                                                                                                                                                               *II
                                                                                                                                                                                                                                                   20100
              AEMS(SO) FEHCT(SO) *XKB(SU) *XKZ(SU) *BHOCW(SO) *ESCW(SO) *EHCW(SU) *
                                                                                                                                                                                                                               WAT
                                                                                                                                                                                                                                                   COTOR
        ORTOR (50) *410X (50) *2002 (50) *200CI (50) *E2CI (50) *E22 (50) *EECI (50) *
                                                                                                                                                                                                                                                   COTOO
                                                                                                                                                                                                                               46
                SICT(50) 'SECTC(50) 'ICS(50) 'IZ(50) 'IX(50) 'BHOCT(50) 'BHOCS(50) '
                                                                                                                                                                                                                               * 8
                                                                                                                                                                                                                                                   00100
        IVC(20), CPC(20), CPS(20), F(20), COMEG(20), DEX(20), EFS(20), HC2(20),
                                                                                                                                                                                                                                                   COTOO
  OIMEM2104 YC(20), SIMP1(20), ZC(20), US(20), YS(20), SIMP2(20), ZS(20),
                                                                                                                                                                                                                                                   00103
                                                                                                                                                                                                                                                    TOTOO
                                                                                                        #XEIOT(80) ON208(80) YEIOS(80)
        OW202(50) * XE102(50) * XC(50)
                                                                                                                                                                                                                                                    TOTOO
                                                                  3CP(Sn)*CP(30)*CA(S0)*CH(SO)*CH(S0)*CTO(SU)*
                 . OWZ01 (SO) .
SCTVWD(50) *2MO(50) *2TVWC(50) *2TVW2(50) *CT(50) *CS(50) *C2(50) * C#(50) *
                                                                                                                                                                                                                               *5
                                                                                                                                                                                                                                                    TOTOC
                                                                                                                                                                                                                                                   16100
  IDE1 (50) *DBS(50) *OBECV(50) *DBF(50) *BCI(50) *BCS(50) *BZ(50) *BCW(50) *
                                                                                                                                                                                                                                                    TOTOO
               DIMERSION XBVB(SU) CF(SU) BHIIN(SU) EKC(SU) DBC(SU) MDOI(SU)
```

```
0000 B 001100 SELOT
                                                   0000 B OUTSEN SELOS
                                                                             0000 E 00112# ZE10S
                             57 #9#TUU & 000U
                                                                                                       43X 034500 X 0000
                                                     SI STUTED & OUCO
                                                                                0000 K 001874 YC
                             32 ##£160 & 0000
 UUUU B UUStitt SEIV
                                                                                9000 E 001S20 XC
                                                                                                       843X 000000 X 0600
                                                     0000 L 005020 XKB
                            UDDO B DUSHIH XKZ
  0000 B 00223t xww
                                                                               DSA OTSFOO N 0600
                                                                                                       HSA 909600 N 0000
                                                    100M 55.000 N 0000
                           TORW 142500 8 0000
BATZW ZAZZOO R OCOO
                                                                                                       оооо к оозалу летн
                                                                              COUR B 602601 VCLL
                                                    DUUG B UUSPIS NOMZ
                          0000 B 002254 AULTE
   2V 892800 9 0900
                                                                                                         DON'S GUIDIO AC
                                                    COUC B DOZETS ACME
                                                                               0000 B 002952 ACM
                           DODD B DUREST ACME
  JOHN B DURROR ACT
                                                                                                         31 950200 8 0000
                                                                              13ST 074500 9 0060
                                                     0000 B 002070 TX
                             11 935800 N 0000
   SII 022100 8 0000
                                                                                                       0000 K 002013 ICM
                                                                               0000 E 001750 TCL
                                                     0000 B 00505D 1CS
                           0000 B 0022## 1EWB
  SB1 01/2/200 8 0000
                                                                                                        TZS 450000 8 0000
                                                                               000c 8 002100 22
                             #S 091200 8 0000
                                                     168 451600 8 0000
  105 041500 8 0000
                                                                                                       0000 B 005590 200CT
                                                                              5005 #£22200 M 0000
                            ITS 400200 8 0000
                                                      15 09/2000 B 0000
   25 USUSUU 8 UUUU
                                                                                                      0000 B 001440 SILBS
                                                                             DOOR K GOODUR STANC
                                                    SWVIS REGOOD & 0000
                            THIS 150000 N 0000
NOUR R PRESENT SOUCH
                                                                                                       0000 R 003626 RT94
                                                      0000 B 002417 BS
                                                                                18 919200 N 0000
                             0000 8 0022S0 BS
 141415 022100 & 0000
                                                                                                        ODDO B DOSPIT KESE
                                                     DUDO B OUZERS KWK
                                                                               0000 B 005574 bt 2
                            Mad 045200 B 0000
 SITA 298500 8 0000
                                                                                                       nonu B unggos brain
                                                                              0000 K DUSRAS BECS
                                                     ÚÚCO B DOZESO BEK
                            STa £29£00 8 0000
 HS74 708500 8 0000
                                                                             овьо в бореко вгсмн
                                                                                                        ооло к олдере вноѕ
                           0000 8 002211 BECT
                                                    DUDO B DUZESS BECME
DOOD B DOZPOD BECTH
                                                                                                       DODE R DOSEST RICEX
                                                                             0000 K 003527 PHOIN
                                                    SOHE #91200 B 0000
                           DOUG R OUSSID RHOX
  TOHG 222500 8 0000
                                                                                                         $0 ZPSERO N 0000
                                                    DODO B DUSESD BHOCK
                                                                              2000 B 002554 RESC
                          0000 B 00S1In BHOCI
 UUUU 6 UUSINU BHOCS
                                                                                                      иповій вопопо вігопи
                                                                                14 888800 H 0000
                                                      0000 B 003620 BS
  0000 B 003240 OEX
                            100 000 B 0000 0C1
                                                                               DADO K DOSCOU PSH
                                                                                                         58 092000 8 0000
                                                      TSa 909500 d 0000
HTMATS ODDOOD R EDOO
                           0002 K 000000 PTCP
                                                                            0000 K 000000 BHDENZ
                                                                                                       0000 B 00133# bEBIC
                                                    NTING 055000 B 0000
                           0000 R 003350 PHIM
00000 B 600000
                                                                               0000 B 060310 PC1
                                                                                                       0000 K 603516 PCFL
                           J179 A78600 A 0000
                                                    0000 R 003575 PC1H
  OUUU B UUUZZE BCS
                                                                             0000 B 001110 0800
                                                                                                       TOSTO CONTROL H ROOM.
                            UDDO B DUURUR SCW
                                                    20500 003100 8 0000
 HWD8 519200 8 0000
                                                                                                          0.000 1 0.000 1
                                                                                 0000 I 0029SV W
                                                    0000 I DUZZZW BETVE
                          0000 B 002570 OMCRO
 BUDU B DUDSITU OVERA
                                                                                                       BATZM ECHEBU I GOOD
                                                     0000 I 00202S FIW
                                                                                 T 129200 I 0960
                             0000 I 002210 TB
   MT 515200 I 0000
                                                                                                         2000 R 001724 DC2
                                                                                TH 955500 8 0000
                                                       I 09-12-00 I 0000
                              P 788800 I 0000
  UUUU I UUSEUN KIN
                                                                                                         0000 K 00$220 E22
                                                                                 0000 B 001004 E
                                                      0000 B 000074 FKC
                            0000 & 0022It CHI
  WUH #19200 8 0000
                                                                                                        0000 8 POSHS# EHET
                                                                               SHE BUSTON BIRL
                                                      DOUG B DURESH EB2
                           UDDO B DUSSHIF EZCM
  1050 HUEZUU B UUGU
                                                                                                       попо в опреси отыкс
                                                     0000 B 005526 EECT
                                                                              0000 B 00Seif EECH
                            UCCO B OUTSON EES
  DODD B DOSEZO EHCM
                                                                                                         nood is coorse thic
                                                                               1300 492000 B 0000
                            134 071000 9 0000
                                                    1014G 053560 B 0000
   0000 B 000014 DDS
                                                                                                          9999 R 900 CS
                                                      DONG B DOZESS DCL
                                                                                6000 B 001010 Cd
                           UDGO & UUSSSI DEFT
   X30 #39100 & 0000
                                                                                                         0000 K 000030 CS
                                                                                0000 B 000044 Cit
                                                      G000 B 000670 C5
   Z3 011Z000 8 0000
                             40 PITORO & 0000
                                                                                                         SHO 099700 B 0009-
                                                                               140 499200 H 0600
                                                      0000 B 000e20 CI
    30 745000 B 0000
                            0000 B 00103# C10
                                                                                                       2000 R 003632 COUST
                                                                              0000 B 002222 COBET
                                                    0000 B 002228 CORES
                            UUUU B OUTRAR CEC
  1000 8 90255 CPC1
                                                                                                       2000 R 202545 CENTC
                                                                                undo B unnust CF
                                                    OUGO E CODUZO CEVAD
 DOUG B DDIESO COMEG
                          0000 B 002221 CLINE
                                                                                1A 192500 R 0000
                                                                                                       STIV SUBSECT Y OFFI
                                                       0000 B 003E08 AS
                            0000 & 003244 PPK
   100 012200 8 0000
                                                                              13A4V 155200 8 6660
                                                                                                        357 35500 8 0000
                                                      44 242500 A 0000
                            TAA 48TS00 R 0000
   SV ZHSZUV B UUUU
                                                                                                         436 $89500 0000
                                                                               326 955000 U908
                                                      0000 000c2t 6dE
                            396 h09h00 0000
  Tuub 924200 1000
```

```
TOT PHILLIGH = 1788.44/STAINELVELVELVELVELVELTP
                                                                                                                                                      U0201
                                                                                                                                         184
                                                                                                                                                      00500
                                                                         V11b = .0.2834 * RT *CL(0)
                                                          A2 = 6.28344R2 * (DELT - XAAR(J))
                                                                                                                                         *11
                                                                                                                                                      11200
                                                                       VI = 0*s32% * BI * X8V8(9)
                                                                                                                                                      97500
                                                                                                                                         *9L
                                                                                                                                                       9/200
                                                                         CF(n) = DEFLY XBAR(u) + DCL
                                                                                                               0 = 1
                                                                                                                                         *11
                                                                                                                                                      0.0574
                                                                                       DO ITO DEMOLYNIN
                                                                                                                                          ¥$1.
                                                                                                                                                      117900
                                                                                                                                          *27
                                                                          100 XBAR(U) =XBAR(U-1)+ 0.001
                                                                                                                                                       7.9200
                                                                                                                                         *T/
                                                                                                                                                      19200
                                                                                               DO 100 9=5'KIM
                                                             bHOS = 0.32*(RHOC + S.*RHOEX)
                                                                                                                                                      00502
                                                                                                                                          *07
                                                                                                                                          +69
                                                                                                                                                      29200
                                                                 KHOI = 0.32*(BHOIN +2.* BHOC)
                                                                                                                                                       19200
                                                                                                                                         *GQ
                                                                      FRUC = 0.5*(PHOIN + RHOEX)
                                                                                                                                                       0.0200
                                                                              C-21VELING AVENUE EOB DENZILA
                                                                                                                                         *19
                                                                                                                                         *99
                                                                                                                                                      09200
                                                                                    PAR = 5081(0.5*(R1**2 + R2**2))
                                                                                                                                                      78200
                                                                                                                                          *69
                                                                                                                                                       99200
                                                                                  VMAET = 0.1047 * RPM
                                                                                                2d-1d = 101dJ
                                                                                                                                                       99200
    AS = 3*1417 * (R2**2 = R3**2)
101417 = 0.1=09
                                                                                                                                                       69200
                                                                  Vb = 2*1dTA * (BI**5+BS**S)
                                                                                                                                         *T9
                                                                                                                                                      99300
                                                                                                                                          *09
                                                                                                                                                      23300
                                                                                                                                          *69
                                                                                                 T + MIT = WIN
                                                                                                                                                      19200
                                                                                                                                          *99
                                                                                                                                                       00520
                                                                                              X348(T) = 0.001
                                                                                                                                          */5
                               WRITE(LW.27) CORFLICOMERICLINE, RPN. WROT. AMP. CF91C
                                                                                                                                                       00537
                                                                                                                                          +00
                                                                                                    MEDIE (CNASS)
                                                                                                                                                       00532
                                                                                                                                         *65
                                                                                                                                                       00533
                                                                                                    MBILE (FA*S3)
                                                                                                                                          + 179
                                                                                                                                                       COSSI
                                                                                                    MEILE (FAYSI)
                                       RELIE (FR. F6) PI.TI. RHOIN. PR. BHOEX. LIM. KSTAR
                                                                                                                                          +54
                                                                                                                                                       00220
                                                                                                    KICLE (CANTA)
                                                                                                                                          PS*
                                                                                                                                                       91200
                                                                                                                                          *TG
                                                                                                    RETAINED BY
                                                                                                                                                       0057#
                                                                                                                                          * () G
                                                                                                                                                       00515
                                                                                                    WHIT (FALTE)
                                    MULLE(FM*T1) BI'85'83'DEFL'DCF'A2'AOFLE
                                                                                                                                                       TOZOO
                                                                                                                                          46b
                                                                                                      MYTHE (FM+6)
                                                                                                                                          *13+
                                                                                                                                                       11100
                                                                                                                                          */ 12
                                                                                                                                                       SATOO
                                                                                                      (Z487) P113/4
                                                                                                                                          *95
                                                                                                                                                       00113
                                                                                                      PELLE (FM+2)
                                                                                                                                          4.54
                                                                                                      ASSILE(FX+3)
                                                                                                                                                       COLYL
                                                                                                                                                       COTEST
                                                                                                      ARTIC(FS*T)
                                                                                                                                                       99100
                                     SA EORANA (ETRIOIDING THAT IN ELTIOIDINA HAR TO THE STAIL TO THE STAIL TO THE STAIL TH
                                                                                                                                          *Ch
                                                                                                                                                       99100
                                                                      I.VEB' IM. SX' COERE CEBICIN)
       S2 EGBPV1(10X',COBEI, 2X',COBES, 2X',CFIME, 2X',BEW,10X',FB,8X*
                                                                                                                                                       SOTON
                                                                                                                                                       #9100
                                                                        TivkhEILCOEi'SX'ioICC E0ICi)
                                                                                                                                          * 0 10
53 FORGERICIOX, OBJETCE COEFFICIENTS, TX. SPEED, AX. BOTOR WEIGHT . 2X.
                                                                                                                                          *60
                                                                                                                                                       #9100
                                                                                                                                                       COTECO
                                                                   ST EONWYJ (SKY) IMMIL NYBYKEIEBRAN)
                                                                                                                                          *90
                                                                                                                                                       00162
                                            19 FORMATICF15.2.F15.3.F15.PF15.3.IIM.II2V/)
                                                                                                                                          *1.5
                                                                                                                                          1/10
                                                                                                                                                       19100
                                                                                              {///*!***************
                                                                                                                                          +95
17 FORMAT (EXTINCT) PSIA: 10X: 11; DEG P: 5X: LGAET**3: 7X: 102. PSIA: 8
                                                                                                                                                       19100
          TICLY BESCHEET SX TOERSILK BHOCK TEXT TWIL X TEXT ELVIN
                                                                                                                                          * +C
                                                                                                                                                       DUTOB
                                                                                                                                                       09100
  TO ECHOLY J (DX . SIVI BRESSOBE . PX . IEMBEBVINGE . 4X . DENZIIA BHOIM . 2X .
                                                                                                                                          *65
                                                       12 ECBNVI(SX**EFRID CONDITION* IMBRIN)
                                                                                                                                          425
                                                                                                                                                       19100
                                                                                                                                         . +15
                                                                                                                                                       OCTOR
                                                                                             II ECHNIAT (MF15.5/V)
                                                                                                                                          *05
                                                                                                                                                       SSIDO
                                                              (/.C**NI dl70A: *X9*, C**** (5A: *Y9)
                                                                                                                                          *63
                                                                                                                                                       99100
        6 FORMAT(9X, 101, 14X, 11M, 11M, 10X, 10ELTA, IN, 16X, DCL, IN,
                                                                                                                                                       #3100
                 IAETANDAYACHAILA CEEVKAARANAANAA AOETANAAALIS CVAILA AOETA
A ECHRALICIALIST, HP ORIELLS, CX. 122, LP ORIELLSY, P3. SUMPLYTY, TOT TRA
                                                                                                                                           *1.2
                                                                                                                                                       #9100
                                                                                 P EODPVI(SK) GROWELEKIN)
                                                                                                                                          *92
                                                                                                                                                       ESTUD
                                3 FORNAT (BOX, BALANCE PISTON STABLITY ANALYSIS*//)
                                                                                                                                                       00122
                                                                                                                                           *47
                                                                                                                                                       19100
                                 VEAD(LR.30) COREL.CORES.CLINE.RPM.WPOI.AMPRICERIC
                                                                                                                                          *92
                                                                                                                                                       01T00
                                                                                                                                          *72
                                 25 BEVO(FR'SO) BILLI'MHOIN-BS'BHOEX'FIM'KRIVB'SEEVE
                                                                                                                                                       00159-
                                                                                          TE (87) 6691860125
                                                                                                                                          *†2
                                                                                                                                                       00153
                                                    21 MEVELLETTED RIPRANCEUTINGLIVS/VOLTP
                                                                                                                                          *02
                                                                                                                                                       90115
```

```
FKC(J)= 0.12 + PHTIM(J)**0.016*(R1/PMR)**1.434*(R1/CL(J))**0.233 -
00302
                    DPC(J) = RMOC * AMVEL**2*FKC(J)**2*(R)**2 + R2**2)/1333740.
00393
                    *JOT(J) =0.53833*SORT((DPTOT+DPC(J))/(1./CORF1**2/A1**2/RHO1 +
00304
        32*
                   11./CURE2**2/A2 **2/RHO2 + 1./CLTHE**2/RHGEX))
00304
                    DP1(J)=HDOT(J)+*2*2.239/(CORF1**2*A1**2*RHC1)
00305
                    DP2(U)=\(\)00T(U)+*2*0.239/(CCINE*+2*A2**2*RH02)
DPL(U) = \(\)01(U)**2*2.239/(CLINE**2*RH0EX)
00306
        85*
00307
                    PC1(J) = P1 - DP1(J)
00310
        87*
                    PC2(J) = PC1(J) - DPC(J)
00511
        86*
00312
                    PS(J) = PC2(J) - OP2(J)
        29*
                    PCM(J) = 0.5*(PC1(J) + PC2(J))
00313
        90 *
                    TC1(U) = PHTEMP(PC1(U) +H1+OC1) +
00314
        91*
                    CPCI = PICP(PC1(J),IC1(J))
00315
         92*
                    PERIC(J) = 0.9223=-08* CERIC * RPM**3*(R1**5 - R2**5) * RHOC
00316
         95*
                    DTFRC = 0.707 * PFRIC(J)/MDOT(J)/CPC1
60317
         94*
                    TC2(J) = TC1(J) + DTFRC
00320
         951*
                    HC2(J) = PTERTH(PC2(J),TC2(J))
00321
         96*
                    TS(J) = PhTFIP(PS(J)+HC2(J)+OS)
00322
        97+
                    TX(J) = PHTELP(PS+NC2(J)+OFX)
00323
        984
                    REOCL(J) = PHOEDS(PCL(J), HI, RLCI) * 1729.
00324
        99*
                    RHOCZ(U) = PHOFNS(PC2(J), HC2(J), RLC2) *1728.
00325
        1000
                    RELOS(U) = PEDENS(PS(U)+HC2(U)+RLS)*1728.
00326
        101*
                    RHOY(J) = PEDENS(P2)HC2(J), RL2) * 1728.
30327
        102*
        103*
                    RHOCH(J) = (RHOC1(J) + RHOC2(J))/2.
00330
                    RHOC = RHOCH(J)
00331
        104*
00532
                    IF (I-1) 114,114,112
        105*
                114 Rm01 = Rm0C1(J) -
100335
        106*
                    RHOS = SOHN
00336
        107*
                    RHOEX = RHOX(J)
00337
        108*
00340
        109*
                    USTAR = WDOT(J)
00341
        110+
                    1 = 1 + 1
                    GO TO 102
00342
        111*
                 112 F(J) = 1.5708 * (R1**2 - R2**2) * (PC1(J) + PC2(J))
        112*
00343
                   1 + 3.1417 * PS(J) * (R2**2 - R3**2)
00343
        113*
                 110 CONTINUE.
00344
        114*
                 50 FORMAT( /2x. CAVITY COMDITION /)
00346
        115*
                  52 FORMAT (9x, +HP GAP+, 11x, +PC1+, 12x, +TC1+, 11x, +RHOC1+, 11x, +PC2+, 12x, -
00347
        116*
                   1.TC21,11X, (RH9021)
00347
        117*
                 54 FOREAT(104, *XUAR*, 11X, *PSIA*, 11X, *DEG P*, 9M, *LB/FT**3*, 8X, *PSIA*,
00350
        110*
                  111X, LES RI, 9X, LB/FT**31/)
00350
        119*
                  50 FORMAT (F15.3,F15.2,2F15.3,F15.2,2F15.3/)
00351
        120*
              WHITE(LW.50)
00352
        121*
                    WRITE (LW.52)
00354
        122+
                    VRITE(LV)54)
00356
        123*
                    WRITE (L.W., 56) (XMAR(J), PC1(J), TC1(J), RH0C1(J), PC2(J), TC2(J), RH0C2(J)
        124*
00369
                   1), J=KSTAR, LIM)
00360
        125*
                  SE FORMATI /2X/'SUMP AND EXIT CONDITIONS'/)
00374
        12n*
               ED FORMAT(40X, SUMP , 33X, FXIT , 18X, FLOW RATE )
00575
        127*
                 62 FURNAT (18X, *XBAR*, 12X, *PS*, 13X, *TS*, 12X, *RHOS*, 12X, *TX*, 12X, *RHOX*
00376
        120*
00376
        129+
                  64 FOREAT (11x, *IN*, 12x, *PSIA*, 10x, *DEG R*, 9x, *LB/FT**3*, 8X, *DEG R*, 9
00377
        130 *
00377
        131*
                   1X, *LB/FT**31,9X, *LB/SEC*/)
                    RRITE(LW/58)
00400
        132*
00402
        133*
                    WRITE(LU)60)
00404
        134*
                    (£64.04 DETENG
                    WRITE (LW 60)
00406
        135*
               66 FORMAT (F15.3,F15.2,5F15.3/)
00410
        136*
                    WRITE(LM:66) (XPAR(J):PS(J):TS(J):RHOS(J):TX(J):RHOX(J):WDOT(J):J=
00411
        137*
00411
                    IKSTAR, LIM)
        130*
               C-SPRING RATE AND FREQUENCY
00411
        139*
```

```
DO 126 JEKSTARALIN
                     DFX(J) = (F(J+1)-F(J))/(XPAR(J+1)-XBAR(J))*12.
        140*
00465
00430
        1414
                     ODEGA(J) = (32.16 * DEX(J)/WROT) *+0.5
        142*
00451
                 128 VC(J) = AP + CL(J) + VOLTP
00432
        145*
                  67 FORMAT (/2X, SPRING PATE AND FREQUENCY //)
                  66 FORMAT (10x, *XFAR*, 4X, *PRESS FORCE*, 3X, *SPRING RATE DEDX*, 4X, *FREOU
        144.
00454
                    IERCY!, 4X, 1315C FRICT!, 3X, 1CAVITY VOL!, 3X, 1FLOW!, 5X, 1K-PRESS!)
        145*
00435
                  70 FORMAT( 11X, 1181, 12X, 11P1, 12X, 11B/FT1, 11X, 10MFGA1, 12X, 1HP1, 8X, 1N*
        140*
00435
        147+
00430
                    1+3+,4X, *COCFF*,4X, *GRADIENT*/)
                  72 FCPMAT(F15.3,F15.1,E15.5,F15.1,F15.3,F10.3,F10.4,F10.3/)
        140*
00430
00437
        149*
                     WEITE (LW+67)
00440
        150*
                     WHITE (LM+63)
        151*
00442
                     WRITE(LW+72) (XBAR(J),F(J),DFX(J),OMEGA(J),PFRIC(J),VC(J),PHIN(J)
00444
        152*
00445
        155*
                    1.EKC(J).JEKSTAR.LIM)
        154*
00440
                     1F (FEAG) 31,31,129
00463
        155*
               C-BULK LODULUS
        156*
00463
               ___129 DO 130 J=KSTAR,LIM
00466
        157*
                     SOUCT(U) = PISOURICPCI(U).TC1(U))/12.
00471
        1554
                      SOUS(J) = PISGUM(PS(J):TS(J))/12.
00472
        159*
                      ESC1(J) = BHOC1(J) * SOUC1(J) **2/4630.
00473
        160*
                      ESS(J) = RHOS(J)+SOUS(J)+*2/4630.
00474
        101*
                      PC1H = PC1(J) + 5.
        162*
00475
                      PCIL = PCI(J) - 5.
         165*
                      VC1H = (PHDEHS(PC1H+H1+RLC1H) * 1728.)**(-1)
00476
         1014
                      VC1L = (PHDERS(PC1L+H1+RLC1L) * 1728.)**(-1)
00477
         165*
00500
                      VC1 = 1./RHOC1(J)
 00501
         106*
                      EHC1(J) = -VC1*10./(VC1H-VC1L)
 00502
         107*
                      PSH = PS(J) + 5.
 00503
         168*
                      PSL = PS(J) - 5.
                      VSF=1./(PHDEAS(PSH)HC2(J),RESH) * 1728.)
         169*
 00504
         173*
                      VSL=1./ (PHOGES (PSL, HC2(U), RLSL) * 1728.)
 00505
         171*
 ამანი
                      VOLS = 1.7RHOS(J)
         172+
 00567
                      EHS(J)==VOLS* 10./(VSH=VSL)
         175+
 00510
                      TCM = (TC1(J) + TC2(J))/2.
         175*
 00511
                      HCM = PTEATH(PCM(J) .TCM)
         175*
 00512
                      SOUCH(U) = PTSOURT(PCM(U),TCH)/12.
         176*
                      ESCH(U) = RHOCH(U) * SOURM(U) **2/4630.
 00513
         177*
 00514
                      POME = POM(J) + 5.
         1.76*
 00515
                      PCML = PCM(J) - 5.
         179*
                      VCMH = 1./(PHDEHS(PCHH, HICM, RLCMH) * 1729.)
 00516
                      VCAL = 1./(PHDEMS(PCML+HCM+RLCML) * 1728.).
         160*
 00517
         161*
 00520
                       Von = 1.7 RHOCH(U)
         162*
                      EHCh (J) = -VCM * 10./(VCMH - VCML)
 00521
                      ELCN(U) = (1./ESCE(U) + (1./EHCM(U) - 1./ESCM(U))*1./(1. + (OMEGA)
 00522
         185*
                      1J) * RHCCH(J) * VC(J)/1728./WDOT(J))**2))**(-1)
          184*
 00523
                      EEC1(J) = (1./ESC1(J) + (1./EHC1(J)-1./ESC1(J))*1./(1.+(OMEGA(J)))
         165*
 00523
                   130 ECS(U) = (1./ESS(U) + (1./EHS(U) - 1./ESS(U))*1./(1.+(OMEGA(U)*
 00524
         136*
 00524
         167*
          156*
                      18HOS(U) * V5 /1728./WHOT(U))**2))**(-1)
  00525
          189*
  ນບວ25
                    80 FORMAT( /2X, BULK MODULUS, PSI+/)
                    82 FCRMAT(10X, 'XBAR', 3X, 'SCUND VEL', 11X, 'CAVITY C1', 18X, 'SOUND VEL', 1
          190*
  00527
          191*
  00530
                    64 FORMAT(11X,**IR**,6X,**F1/5**,6X,**E(S)**,6X,**E(H)**,6X,**E(E)**,10X,**FT/S*....
          192*
  00530
          193*
  00531
                      1,7X, 1E(S) 1,6X, 1E(B) 1,6X, 1E(E) 1/)
          194*
  00531
                    86 FORMAT (F15.3,4F10.1,F15.1,3F10.1/)
          195*
  00532
                       FRITE(LW,80)
          190+
  00533
                        ERITE (LV+B2)
          197*
  00535
                          TYPE ( W. A. ) (YRAR (J) . SOUCT (J) . ESC1 (J) . EHC1 (J) . EEC1 (J) . SOUS (J) .
                        WRITE (LW+S4)
  00537
          198 ×
```

```
1855(U) FEHS(U) FRES(U) FUENSTAR FLIM)
00541
              200+
                              310 FURNAT(//10X, 'XPAR', 3X, 'SOUND VEL', 7X, 'MEAM CAVITY')
00557
              201+
                              312 FURNAT (11%, *11% +6X, *FT/S*, 6X, *E(S) *, 6X, *F(H) *, 6X, *E(E) */)
00560
              2021
00561
              203*
                              314 FORMAT (F15.3:4F10.1/)
00562
              204*
                                     FRITE(LW, 310)
                                     WKITE (LW, 312)
00564
              2054
                                     WRITE(LW.314) (XBAR(J).SOUCM(J).ESCM(J).EHCH(J).FECM(J).J=KSTAR.L
00566
              206*
                                   1191
00566
              2074
                          C-COEFFICIENTS
UUbtio
              206*
                                     DO 140 JEKSTARALIN
00680
              209*
J0603
              210*
                                     CUMEG (J) = XBAR (J) / (DELT-XBAR (J))
00504
              211×
                                     CLAMD(J) = (P1-PC1(J))/(PC2(J)-PS(J))
                                     SBU(J) = (P1 - PC1(J))/(PS(J) - P2)
00605
              212*
              213+
                                     SLAMC(J) = 1.- (P1-PC1(J))/SEC1(J)
00600
                                     SLAMS(J) = 1.- (PC2(J)-PS(J))/EFS(J)
00007
              214*
                                     C1(J) = 1.+ COMEG(J)
00610
              215*
                                     C2(J) = RHOCM(J)*AP*X3AP(J)/WDOT(J)/1728.
00611
              216*
                                     CS(J) = SEARC(J) + CEATE(J)
00612
              217*
                                     C4(J) = REDCE(J) * VC(J)./WDOT(J)/1728. *2.*(P1-PC1(J))/EECM(J)
00613
              213*
                                     CS(J) = AUS(CLAMD(J)*SLAMS(J))
00614
              219+
                                     CB(J) = ABS(COMEG(J))
00615
              220*
                                     C7(J)=RHOS(J) * AS * XBAR(J)/WOOT(J)/1728.
              221*
00010
00617
                                     CE(J) = CLAPU(J) * SLAMS(J) + SMU(J)
              222*
                                     C9(J)=RHOS(J)* VS/VDOT(J)/1728. * 2.*(P1=PC1(J))/EES(J)
00620
              223*
                              146 C10(J) = A35(CLAMD(J))
JUBZI
              224*
                               73 FORMAT (/2x, 'CCEFFICIENTS'/)
00623
              225*
                              J74 FORMAT(10X, *XBAR*, 7X, *CAP OMEGA*, 6X, *CAP LAMBDA*, 9X, *SMU*, 10X, *LAM
00624
              220 t
                                   180A C1,7X, LAMSDA S1)
              227*
00624
                                76 FORMAT(11X, *IN*, 10X, *COMEG*, 9X, *CLAMD*/)
00n25
              225*
00626
              2294
                               78 FURMAT(F15.3,5F15.4/)
              2304
                                     VRITE(L*)73)
00627
00631
              231×
                                     WKITE(LU+74)
                                     WHITE (LK+76)
00633
              252*
                                     WRITE(LM+78) (XBAR(J), COMEG(J), CLAMD(J), SMU(J), SLAMC(J), SLAMS(J), J
00635
              233*
              234*
                                   1=KSTAK,LIM)
00635
                                88 FURNAT ( /2X, 'COEFFICIENTS'/)
00650
              235*
                                96 FORMAT(10x, 1X6AF1,6x, 1C11,8x, 1C21,8X, 1C31,8X, 1C41,8X, 1C51,8X, 1C61,
00051
              2364
                                   18X, 1071, 8X, 1081, 8X, 10918X, 10101/)
00051
              237*
                         92 FOREAT (F15.3, F8.4, E12.3, F10.4, E12.3, F10.4, F8.4, E12.3, F10.4, F10.6,
26000
              235*
                                   1Fe.3/)
00652
              239*
              240*
                                     WHITE (L# 83)
00053
00655
              241+
                                     TRISE(LA)90)
                                     MATE(LW+92) (XBAR(J)+C1(J)+C2(J)+C3(J)+C4(J)+C5(J)+C6(J)+C7(J)+
00657
              2424
                                    108(J), C9(J), C18(J), J=KSTAR, LIM)
              243*
00057
                                     DO 150 JEKSTAR, LIM
00577
              244*
00702
                                     XKP(J) = C2(J)/C4(J)
              2454
                                     O_{PS}GL(J) = (CL(J)*CR(J) - CS(J)*CG(J))/(C2(J)*C9(J))
00703
              246*
                                     ZETOI(J) = (CI(J) * C9(J) + C2(J)*CR(J)+C7(J)*C5(J))/(C2(J)*C9(J))
              247*
00704
                                     (U) = (U) = (U) + (U) 
00705
              240*
                                     ZETOZ(J) = (C4(J)*C9(J) + C3(J)*C9(J))/(C4(J)*C9(J))
00706
              249*
00707
              256*
                                     XKS(J) = C7(J)/C9(J)
                                     06.563(J) = (01(J)*010(J) - 03(J)*06(J))/(04(J)*07(J))
00710
              251*
                               150 \ ZETO3(J) = (C2(J)*C10(J) + C3(J)*C7(J) -C4(J)*C6(J))/(C4(J)*C7(J)
00711
              252*
              253*
00711
              254*
                                93 FURMAT (/2X; INTERMEDIATE VALUES!/)
00713
                                94 FORMAT(10X, *XBAR*, 6X, *KP*, 6Y, *OMEGA1**2*, 6X, *2ZETOM1*, 6X, *OMEGA2**
00714
              255*
                                   12:,5X,:2ZETOH2:,7X,:KS:,7X,:0MEGA3**2:,6X,:2ZETOM3:/)
00714
              25ö+
                                96 FORDAT(F15.3,F10.4,4E13.4,F13.4,2E13.4/)
00715
              257*
                                     WRITE(LU,93)
00716
              256*
              259*
                                   VRITE(LU+94)___
00720
```

```
00722
                    %ACTIE(LM+96) (XPAR(J),XKP(J),OMSQ1(J),ZETO1(J),OMSQ2(J),ZETO2(J),
        266+
                    1AKS(J),OMSO3(J),ZETO3(J),J=KSTAR,LIM)
00722
        2014
Cu740
        2621
                    CO 160 J=1.4 In
00743
                    ERS = NEPYXPAR(d)
        205*
                    XC(J) = ZETO1(J)*OYEGA(J)/(OMSO1(J) - OMEGA(J)**2)
00744
00745
                    YC(J) = Zeroz(J)*omega(J)/(omega(J)*omega(J)**2)
                    SIMP1(J)=(XC(J)-YC(J))/SORT((1.+XC(J)**2)*(1.+YC(J)**2))
00746
                    2C(U) =XKP(U)*ZFT01(U)/2FT02(U)*YC(U)/XC(U)*SQRT((1.+XC(U)**2)/(1.
00747
                   1+YC(J)++2))
00747
        20134
                    US(J) = ZEIO3(J)*OMEGA(J)/(OMSO3(J)*OMEGA(J)**2)
00750
        269*
                    YS(U) = YC(U)
00751
        27ú*
00752
        271 *
                    SIEPZ(J)=(US(J)-YS(J))/SORT((1.+US(J)**2)*(1.+YS(J)**2))
00753
        272+
                    Z5(J) =XK5(J)*ZETO3(J)/ZETO2(J)*Y5(J)/U5(J)*SQRT((1.+H5(J)**2)/(1.
00753
        275+
                   1+15(3)++21)
                    CPC(J)=0.2834*AP*(P1-PCF(J))* XBAR(J)*EPS**2 * ZC(J) * SINP1(J)
00754
        274*
                    CES(J) = 6.2834 *AS*(P1-PC^{(J)})*XBAR(J)*EPS**2*ZS(J)*SINP2(J)
00755
        275 r
                160 \text{ CPT}(J) = \text{CPC}(J) + \text{CPS}(J)
00756
        276*
                299 FOREAT(/2X; IDTERMEDIATE VALUES!/)
00760
        271*
                300 FOREAT(10X, *XBAR*, 6X, *X*, 8X, *YC*, 7X, *SIN(PSI1)*, 4X, *ZC1*, 7X, *U*, 8X
00761
        278*
00761
        279*
                   1, 'YS', 6X, 'SI'((PSI2)', 4X, 'ZS2'/)
                302 FURNAT(F15.3,8F10.4/)
00762
        280 *
00763
        281 *
                    WRITE(Lux299)
00765
                    WRITE (LW. 300)
        282*
                    WRITE(LW,302) (XBAR(J), YC(J), YC(J), SINP1(J), ZC(J), US(J), YS(J),
00767
        285+
                   1SIMP2(J), ZS(J), J=RSTAR, LIM)
00767
                304 FORMAT (/2X; *STABILITY PARAMETER*/)
01005
        205*
                320 FURRAT(/32x+!PORK PER CYCLE!/)
01000
                306 FORMAT(10x, *XBAR*, 9X, *CPC, INLR*, 6X, *CPS, INLR*, 6X, *CPT, INLB*/)
01007
        2874
                30s FCRMAf(F15.3,3F15.4/)
01010
        286.*
01011
        289*
                    WRITE(LU:304)
01013
        290 €
                    WRITE (L4/320)
        291+
                    WRITE (L. 9) 306)
01015
                    WESTER (LW. 308) (XSAR(J).CPC(J).CPS(J).CPT(J).J=KSTAR.LIM)
01017
        245*
              C-ROOTS
01017
        2934
                    DO 180 JEKSTAR/LIM
01030
        294*
                    FRT(J) = Z2T01(J)/2./(1.+AS*XKS(J)/AP/XKP(J))*(1.+AS*XKS(J)/AP/XKP
01033
        295*
                    1(J)*ZET03(J)/ZET01(J))
01033
        245 K
                    ART(U)=0MS 11(U)/(1.+AS*XKS(U)/AP/XKP(U))*(1.+AS*XKS(U)/AP/MKP(U)*
U1034
01034
        298+
                   10p.503(J)/0MS01(J))
                    RII2 = HRT(J)**2 - ART(J)
01035
                    IF(RT12) 172+170+170
01033
                170 S1(J) = -BRT(J) + SORT(RT12) .......
01041
        301*
                    S2(J) = -3RT(J) - SORT(RT12)
        302*
01042
                    SiI(J) = 0
01114.5
        303*
01044
        30.4*
                    S2I(J) = 0
                    GO TO 174
01045
        305*
                172 S1(J) = -6RT(J)
01046
        300*
                    $2(J) = $1(J)
01047
        307*
                    S11(J) = SQRT(ABS(RT12))
S21(J) = -S11(J)
01050
        30c*
01051
        304*
        310* ____174 RT34 = (ZET02(J)/2.)**2 = 0/15Q2(J) _____
01052
01053
                    IF (RT34) 178,176,176
        311*
                176 S3(J) =-ZET02(J)/2.+S@RT(RT34)
01056
        312*
               $4(U) =-ZETO2(U)/2.-SCRT(RT34)
01057
                    531(J) = 0
01060
        314*
                    S41(J) = 0
01061
        315*
                    GC TO 179
        316+
01062
              178 S3(J) = -ZET02(J)/2.
01063
        317+
                    S4(J) = S3(J)
        316*
01064
                    SJI(J) = SQRT(ABS(RT34))
01665
        319+
```

```
SET(J) = SORT(APS(RT34))
01066
              3204
              321+
                              179 CONFIRME
Ulue.7
                              TEN CONTINUE
01070
              3224
                              322 FCPMATE /2X+ TROOTS!/)
01072
              3231
                              324 FGRMAT( 10X, *XBAR*, 12X, *ROOT 51*, 19Y, *ROOT 52*, 19X, *ROOT 53*, 19X,
01073
              36.44
                                   1'ROOT 591)
01075
              325*
                              326 FORMAIL 11X, INT, 9X, INFALI, 7X, IMAGI, 11X, IPEALI, 7X IMAGI, 11X,
01074
              3=12+
                                    1+REAL+,7X, +IMAG+,11X, +REAL+,7X, +IMAG+/)
01974
              327+
                              326 FORMAT(F15.0+E19.4+E12.4+E14.4+E12.4+E14.4+E12.4+E14.4+E12.4+)
01975
              326*
                                     watte (Fr. 302)
01676
              3291
                                      WRITE (LW: 324)
              334*
01100
01102
              331 *
                                      WRITE(La.309) (XBAR(J).51(J).511(J).52(J).521(J).53(J).531(J).
61104
              3324
                                    154(J),54I(J),J=K51AR,LIM)
01104
              335*
                           C-ROOT LOCUS METHOD
                                                                                                                  The state of the s
01104
              334+
                               329 FORMAT (7/2X, TROOT LOCUS METHOD!//)
01122
              335*
                               336 FUPNAT (10X, 1XDAP1, 4X, 1POOT LOCUS GAIN1, 2X, 130DIE PLOT GAIN1, 4X, 1MA
01123
              3300
                                    16 OPER JOX, COSSOVER FREQUITEX, PHASE MARGINE)
01123
              33/4
                               331 FORMAT(///SX: *** MURRER OF ITERATIONS EXCEEDED!///)
61124
               3301
                               332 FORMAT (11X, 1151, 7X, 16RL, 1/5**21, 7X, 1K, 1/5**21, 7X, 1LOOP KGH11, 4X,
01125
               339+
                                    1 tor CRO. RAD/SEC+,4X, PHIM DEG!/)
01125
               346*
                               334 FCRNAT(F15.3, 2E15.5, 3F15.4/)
01125
               3414
                                      DO 198 JEKSTARILIN
01127
               342+
01132
               34.51
                                      1: = 0
01135
               3444
                                      TES(1)= SI(U) ...
01134
               3451
                                      165(2)= 52(J)
                                      1(5(3) = 53(0)^{-1}
01135
               346*
                                      TES(4)= S4(J)
01136
                                      REK(J) = 772.4 (P1-PC1(J))*(AP*XKP(J)+AS*XKS(J))/XPAR(J)/WROT
01137
               3454
                                      Fark (a) = REK (J) *S1 (J) *S2 (J) /S3 (J) /S4 (J)
01140
               369*
                                      OHORO(J) = SORT(SPK(J))
01141
               350*
                               182 Grd (U) = BPK (U) / OP CRO (U) **2*SQPT ((1.-OMCRO (U) **2/S1 (U) / S2 (U) ) **2
01142
               351*
                                     1+(00/Chu(J)/S1(J)+O*CRO(J)/S2(J))**2)/S0RT((1.-0MCRO(J)**2/S3(J)/S4
01142
               352*
                                    2(J))++2 + (OMCRO(J)/S3(J)+OMCRO(J)/S4(J))**2)
01142
               3554
                                      IF (ABS(GH1(J)-1.)-.01)182.182.184
01145
               354*
                               184 # = 2
01146
               3554
                                      00 190 L=1.2
01147
               ∫56*
                                      IF (ONCRO(J)/ABS(TES(L)) -1.) 190,188,188
               3574
01152
                               186 N = H-1
01155
               355*
                               190 CONTINUE
01156
               359+
                                      10 195 L=3,4
01160
               ジい()*
                                      IF (OHCRO(J) /ABS(TES(L))-1.) 195.194.194
01163
               301*
                               194 !! = 61+1
Jlion
               352+
               303*
                                195 CONTINUE
01167
                                      OMCRO(J) = OMCRO(J) * GH1(J)**(1./M)
01171
               354 *
                                      1F(H=10) 181,181,196
01172
               3004
                               181 N=!!+1
01175
               300*
                                      60 TO 183
01170
                               196 WEITE (L:1/331)
01177
                               182 00 197 L=1.4
01261
               3091
                                197 TEPP(L) = DMCRO(J)/ABS(TES(L))
               3711 *
01204
                                198 PHIM(U) =(ATAR(TEMP(1))+ATAN(TEMP(2))-ATAN(TEMP(3))-ATAN(TEMP(4)))
01205
               371*
               372 ×
                                  - 1*57.296
012.05
                                      WRITE(U4+329)
 01210
               373*
               3744
                                      WHITE (LW+35°)
 01212
                                      URITE (LN. 332)
 01214
               375,*
                                      BRITE (LW + 33 F) (XBAR(J) + RLK(J) + APK(J) + GH1(J) + OMCRO(J) + PHIM(J) + J=KST
  01215
               376.
                                     TARFLISH
                517+
  01215
```

```
II (PHIM (J)) 201+203+205
01234
                  201 YPM(U); =1.8+38
01237
        381*
01240
                      ZETA(J) = -100.
        302*
01241
                      XSP(J) = 1.F + 38
        385*
01242
                      TSET(J) = 1.6+38
        3.34 K
01243
        3854
                      GO TO 225
01244
                  203 \times \times (J) = 1.0+38
        3504
                      ZLTA(J) = 0.
01245
        307 +
                      XHP(J) = 2.
01246
        380+
01247
                      TSET(J) = 1.E+38
        300 a
        390 +
                      66 TO 225
01250
                  205 IF (PHIM(J)-90.) 211,213,215
01251
        341*
                  211 Xam(U) = 1.75IN(PHT/4(U)757.296)
01254
        392+
                      Z_{E}TA(U) = 0.707 * SORT(1.-SORT(1.- (SIN(PHIM(J)/57.296))**2))
01255
        393 x
01256
        3944
01257
        3451
                  213 XMM(J)=1.
                      ZETA(J) = 0.707
01260
        3964
                      60 10 217
        397*
01261
                  215 IF (PHIS(J) - 180.) 221.221.223
        3981
01262
        3994
                  221 Xear (J) = 1.
01265
                      ZLTA(J) = 0.707 * SORT(1.+SORT(1.-(SIM(PHIM(J)/57.296))**2))
01260
        400*
                      60 10 217
01267
        461*
01270
                  223 YMM(J) = 1.
        402*
                      ZETA(J) = 100.
01271
        403+
01272
        406.4
                      x \Vdash (U) = I.
01273
                      1581(J) = 1.6+38
        4054
                      GO TO 225
01274
        4664
01275
                  217 CONST = 3.1417 * ZETA(J)/SORT(1.-ZETA(J)**2)
        407*
                      X/P(J) = 1.41./2.718**COMST
01276
        400*
01277
                      TSET(J) = 4.775TA(J)70MCRO(J)
        41144
                  225 CONTINUE
01500
        4103
                  336 FURNAT (//SX) 'RESPONSE 1//)
01362
        41114
                  338 FORMATODX, TXDAPT, 3X, *FPEOU RESP AMPLT, 3X, *STEP RESP AMPLT, 3X, *DAM
01305
        412+
01363
        413+
                    THING! ANX ASSETTLING TIME!)
01304
        414*
                  340 FORMAT(11X, *101, 6X, *XMM*, 18X, *XMP*, 10X, *ZETA*, 8X, *TS, SEC*/)
01505
        415+
                  342 FORMAT (F15.3,2F15.4,2F15.3/)
01306
        4104
                      Ex116 (LY) 336)
                      WRITE(LM 338)
01310
        417*
01518
                      ERITE (UN. 340)
        4134
                      WRITE(LW+3+2) (XBAR(J)-XMM(J)-XMP(J)-ZETA(J)-TSET(J)-J=KSTAR-LIM)
01314
        4144
01326
        420*
                      60 TO 31
                  999 STOP
01327
        421*
01330
        422*
                      EnD :
```

FID OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

	۲9 ۱ ° ۱						
	231 11	669*85	£9.7401	644°4	52.687	1194.29	510.
The state of the s	S71.4	672,88	1030.52	Σ£η•ή	52.882	09*5411	ττο•
·	991.4	28*008	1007-20	4.412	971.53	1120°28	010.
®;	ፈቱፕ•ቱ	#S0 •8S	975.92	#8ۥ#	96†°£9	1116.87	600*
	h11: h	28*5##	46.456	745.44	676.55	1073.28	800.
	990°h	509.85	; †8*Z88	102.4	284•48	10.18.11	۲00۰
	₹66 . ₹	496 • 89	72 . 918	#*5#2	806*119	#6°096	900*
Proved a link home desired and a link and a	016.€	049*69	04.947	971.4	#6 € *99	874,22	900
· · · · · · · · · · · · · · · · · · ·	In8.5	90°3d2	60.176	₩60°₩	\$06 * \$\$	18.567	#00 *
	£99 °£	149*19	06.100	810.4	185.381	69*817	£00•
	\$\$ †*£	£85•£9	81.948	996•2	£77.48	Z6*999	200•
	\$*622	Z96 * 89	24•IIS	2*670	190*45	94*119	T00*
	RHOC2	TC2 DEG R	SD9 AIS9	LB/FT**3	121 9 aag	PC1 AIS9	949 9H 8ABX
					172		CAVITY CONDITION
	Principles and a set of the second of the se					THE RESEARCH PROPERTY AND ADDRESS OF THE PROPERTY ADDRESS OF THE PROPERTY AND ADDRESS OF THE PROPERTY ADDRESS OF THE PROPERTY AND ADDRESS OF THE PROPERTY	
			0010 .22-0	000•89	24700.0	009. 028.	058*
,			WE IN COEFF CF		MGR MGR	совьѕ сгіиЕ	COBET
	THE REPORT OF THE PROPERTY OF	J1	MPLITUDE DISC FR	A THEIRW ROTOR	0000	E COEFFICIENTS	OSIFIC
·	PARTIES II CONTINUE II III II II II III III III III III I	A W. (111. 11. 11. 11. 11. 11. 11. 11. 11.	as 3510 adilligh	14 TH913W 80108		S COEFFICIENTS	ZASTEMARAR TURNI DITIRO
·•		91	2°200	00.884	0010	25.50	
		A 100 (100 (100 (100 (100 (100 (100 (100	£8/F1**3 3.500		00か°か	25°20	ZABTEMARA9 TU9VI
•		81	£8/F1**3 3.500	P2. PSIA	00か°か	TEMPERATURE T1. DEG R 52.50	PI, PSIA 1235.00 10PUT PARAMETERS
	₩ £\$*	81	£8/F1**3 3.500	P2. PSIA	00か°か	TEMPERATURE T1. DEG R 52.50	STAT PRESSURE AL, PSIA 1235.00 1235.00
	TIP CAVITY VOL ***NI 9710V *55.	X LIWIT	.050 DENSITY RHOEX LB/FT**3	STAT PRESSURE PS AIR9 AIR9 4S9	## OENSILA BHOIN	INPUT TEMPERATURE TI, DEG R 52,50	FLUID CONDITION, STAT PRESSURE PI, PSIA 1235.00

	4007.03	52.545	4.459	1060.00	59.368	4.150	
.013	1207.92	52.443	4.466	1068-91	60.370	4.118	
•014	1217.71		4.471	1075.42	61.871	4.065	
•015	1224.59	52.371	And all binder and and a second a second and	1080.57	64.226	3.976	
.016	1229.28	52.322	4.475	1085.71	68.323	3.814	
.017	1232.31	52.290	4.477	1094.19	77.224		
.018	1234.10	52.272	4•478	1094+19			
UMP AND EXIT CON	DITIONS			to and provided the control of the c		The state of the s	
		SUMP			IT RHOX	FLOW RATE WDOT	
XBAR IN	PS PSIA	TS DEG R	RH0S LB/FT**3	DEG R	LB/FT**3	LB/SEC	
.001	500.89	68•759	2.934	68.716	2.929	.987	
.002	507.62	63.426	3.400	63.370	3.386	1.912	
•003	516.90	61.402	3.552	61.345	3.526	2.731	
.004	526.75	60.422	3.628	60.387	3.590	3.398	
•005	535,15	59.928	3.671	59.913	3.622	3.879	
•006	540.70	59.763	3.688	59.759	3.633	4.164	
•007	542.96	59.749	3.692	59.747	3,634	4.273	
•008	542.25	59.742	3.691	59.740	3.634	4.240	
.009	539.30	59.812	3.683	59.805	3.630	4.094	
.010	534.86	59.982	3.667	59,965	3,619	3.862	
.011	529.61	60.254	3.643	60.225	3.601	3.568	
.012	524.05	60.648	3.610	60.606	3.576	3.228	
.013	518.58	61.184	3.568	61.130	3.540	2.855	
.014	513.47	61.950	3.511	51.888	3.489	2.459	
.015	508.93	63.073	3.429	63.014	3.413	2.045	
.016	505.08	64 • 584	3.303	64.529	3,292	1.619	
•017	502.01	67.260	3.078	67.211	3.070	1.180	
.018	499.79	72.506	2.553	72.467	2.549	•724	

				Company of the Compan				and the second s	** * * ***
IN	LB	LB/FT	OMEGA	HP		IN**3	COEFF	GRADIENT	
.001	49681.2	•38762÷08	4281.6	56.82	2	•321	.0175	•485	
.002	52911.3	55848+08	5139•3	61.01	8 4	•244	0341		
.003	57565•3	•68872+08	5707.2	63.28	9 4	•166	.0490	•498	
.004	63304.6	•73789+08	5907.4	65.03	4 4	•089	.0612	•502	
.005	69453•7	70234+08	5763.4	66.60	9	•012	•0700	- •506	
.006	75306.5	.61144+08	5377.5	67.89	1 3	935	•0756	•509	
.007	80401.9	•49821+08	4854.1	68.92	0 3	8 • 857	.0784	•512	annual to take
.008	84553•7	38953+08	4292.1	69.70	7 3	.780. <u> </u>	0788	515	
•009	87799•8	29545+08	3738.0	70.27	3 3	3 .7 03	.0772	-518	
.010	90261.8	.21887+08	3217.4	70.65	9 :	625	.0742	.520	٠-,
.011	92085+8	•15914+08	2743.5	70.88	8	5.548	0700	_ •523	
.012	93412.0	•11365+08	2318.4	70.97	'5 Š	3.471	.0648	•525	
.013	94359.0	.80101+07	1946.4	70.92	5	3•394	.0587	•528	
.014	95026•5	55972+07	1627.0	70.72	22 :	3.316	0519	530	
.015	95493.0	•39945+07	1374.5	70.32	25	3 • 239	.0443	•532	
•016	95825•9	•32428+07	1238.4	69.62	23	3.162	.0361	•534	
.017	96096.1	40749+07	1388.2_	68.30	6	5 • 084	.0271	_ • 535	
.018	96435•7	.10524+08	2231.0	65.19	3 3	3 • 007	.0173	•535	
BULK MODULUS, P	SI		Company of the second control of the second						
XBAR IN	SOUND VEL FT/S E(S)	CAVITY C1	E(E) .	SOUND VEL FT/S	E(S)	SUN E(H)	P E(E)		
.001	3317.7 9294.	3 3860.8	9287•0	2334.5	3453.7	1563	9 3449.	4	
,002	3399.09870.	73906.3_	9848•7	2723.5	5446.8	2369	95432•	6	
.003	3507.0 10674.	3968.1	10630.4	2381+2	6367.9	2635	.5 6340.		
.004	3634.8 11683.	3 4043.2	11606•3	2 766 • 1	6894.4	2774	8 6851.	3	
.005	3749.512679.	24123.6	12554•2	3014.2	7202.7	2850	7141.	0	
.006	3854.3 13619.	2 5058.8	13473.7	3334.8	7335.8	2878	7252.	6	
.007	3919.5 14270.	2 5126.0	14061.1	3)39.9	7367.7	2882	0 7260.	0	

	the second of the second of the			1	. 1944 - Alexandria de la composición dela composición de la composición de la composición de la composición dela composición de la composición dela composición dela composición de la composición dela composición de la composición de la composición dela	name Majorio Awaria	a supposition of the state.	80.4 34	Carlos Carlos	The second second second	Q 94.
-		in the second	and the second	Linconson			en e				
								THE PERSON NAMED IN COLUMN TWO	The state of the s		
 •009	4039.5	15449.6	5224.7	15054+6	3029.1	7298.9	2870.0	7136.5			
.010	4080.0	15862.1	5258.3	15350 • 1	3010.3	7176.8	2842•4	6987•0			
 .011	4110.3	16175.6	5283.5	15534.9	2982•6	6999•4	2800•3	6784.5	and the second s		Age And School or the Parish
012	4132.6	16409•4	5302•1	15633•1	2945•8	6766•8	2741.7	6531.3	en e		
.013	4148.7	16577.4	6123.4	15839•3	2899•2	6477•9	2665•5	6230.1			
 .014	4160.3	16696.9	6133.1	15872.6	2837.1	6103.6	2561.9	5857.3	- management and the second second second	,	National and American St. St.
 015	4168.5	_16781.0	6139.9_	15937.0	2751•1	5605•9	2419.3	5386•7			
.016	4174.0	16838.3	6144.6	16140.4	2636•1	4957•9	2213.1	4804.1			
 •017	4177.6	16875.5	6147.7	16552•2	2439.8	3957.0	1777.0	3896.0			
 018	4179.7_	_16897.4	6149.5	16846.4	2115.2	2467 • 0	1162.3	2459.4			
XBAR IN	SOUND VEL FT/S	MEAN E(S)	CAVITY E(H)	E(E)							
.001	2873.8	6120.1	2562.8	6113.9	mandated to the second		and the second s				
 002	3125.4_	7817.4	3464.3	7801.0	-						<u></u>
.003	3285.5	8956•9	3680.4	8922•9							
.004	3439.6	10086.9	3814.4	10024.7	nakori si misikusi sa mai a i i a - mi kerekernan yéndik iyi yén i						
 .005	3583.9	11215.9	3912.1	11109+8							
.006	3695.0	12151.4	3997.8	11986.0							
.007	3787.3	12959•6	4911.4	12775•2							
 .008	3851,4	13554.6	4969.8_	13296 • 0							
•009	3900.9	14018.1	5011.6	13670.4	•						
.010	3935.9	14349.1	5032.8	13899•2							
 .011	3958.7	14562.9	5038.8	14001.6				· · · · · · · · · · · · · · · · · · ·			
.012	3971.2	14673.3	5030.8	. 13996 • 2	· .						
.013	3974.5	14686.7	5008.3	13901.4			,		· ·		
 .014	3968.5_	_14600.1	4969.0	13733.4		-					
.015	3951.6	14395.0	4906.3	13520+8							
.016	3919.1	14017.6	4807.6	13309.3						9	•

	a management of the second	- A Company of the Co						
.018	3706.2 11730	94255.4	11685•3			and the second s		w page annual designation design settled to the set
COEFFICIENTS								-:
XBAR IN	CAP OMEGA	CAP LAMBDA	SMU	LAMBDA C	LAMBDA S			
.001	•0526	59.1410	215.8410	•9329	• 9969			:
.002	•1111	14.9919	60.0628	.9413	•9929	AND A PERSON OF THE PERSON OF		
.003	1765	6.1176	27.3187		.9867		na maranganan na malayi ki diki dayi salayan si masay si sama	
.004	•2500	3.0566	15.3449	•9620	•9789			
•005	•3333	1.7054	9.7112	.9713	•9704			
006	•4286	1.0197	6.6524	.9789	.9616			
•007	•5385	.6381	4.8241	•9846	•9532			
.008	•6667	•4118	3.6546	•9889	•9457		the state of the s	
	.8182	.2705	2.8602	•9922	•9388			
.010	1.0000	•1792	2.2955	•9945	•9324			
•011	1.2222	•1186	1.8793	•9962	•9262			
012	1.5000	0778	1.5628	• 9974	•9198			
.013	1.8571	•0500	1.3160	•9983	•9131			
.014	2.3333	.0311	1.1175	•9989	•9052			
.015	3.0000	+0184						
.016	4.0000	•0099	.8088	•9996	•8802			
•017	5.6667	•0046	.6715	•9998	•8502			
.018	9,0000		.5061	• 9999				
COFFETCIENTS		·		,				
COEFFICIENTSXBAR	C1 C2	C3	C4 C5	C 6	′ c7 c8	C9	C10	
•001	*			02 •0526	.200-04 274.801	2 .002613	59.141	
.002				551111	.239-04 74.948	4 .000920	14.992	*
-	1.1765 .189-		•392-03 6•03		.262-04 33.354	9 •000515	6.118	

•006	1.4286	.266-03	1.9986 .	107-03 •9806	. 4286	.357-04	7.6329000169	1.020	The second secon
•007	1.5385	•306-03	1.6227	742-04 .6083	•5385	.407-04	5.4324 .000125	•638	
•008	1.6667	•357-03	1.4008	531-04 • 3894	•6667	•468-04	4.0440 .000095	.412	
•009	1.8182	.419-03	1.2627	386-04	8182	544-04	3.1142000072	.271	
.010	2.0000	•497-03	1.1736 .	284-04 •1670	1.0000	-638-04	2.4625 .000056	•179	
.011	2,2222	•593-03	1.1148 .	210-04 •1098	1.2222	•755-04	1.9891 .000043	•119	
.012	2.5000	.716-03	1.0751	156-040715	_1.5000	902-04	1.6344 .000034		
.013	2.8571	·877 - 03	1.0483 .	115-04 •0457	1.8571	•109-03	1.3617 .000026	•050	
	3.3333	•109-02	1.0300 .	843-05 •0282	2.3333	.134-03	1.1456 .000020	•031	
.015	4.0000	140-02	1.0177	602-050164	3.0000	169-03		018	
.016	5.0000	·187-02	1.0096	411-05 .0088	4.0000	-220-03	•8175 •000012	.010	
.017	6.6567	•267-02	1.0045 .	260-05 .0039	5.6667	-298-03	•6754 •000009	•005	
.018	10.0000	440-02	1.0015	147-05 • 0012	9.0000	427-03		.002	
INTERMENTATE V	AL DES			•	•				
INTERMEDIATE_V XBAR	'ALUES	OMEGA1**2	2ZETOM1	OMEGA2**2	2ZET0M2	KS	OMEGA3**2	2ZETOM3	
		OMEGA1**2	2ZETOM1 •1148+06		•				
XBAR	КР			OMEGA2**2	2ZET0M2	KS	OMEGA3**2	2ZETOM3	
XBAR .001	KP •08 7 7	•7041+09	.1148+06	OMEGA2**2 •2809+10 •1496+10	2ZETOM2 •1390+06	KS •0077	OMEGA3**2 •1667+10	2ZETOM3 •2906+06	
XBAR .001	KP •0877 •2458	•7041+09 •5117+09	•1148+06 •9011÷05	OMEGA2**2 •2809+10 •1496+10 •9843+09	.2ZETOM2 .1390+06 .1041+06	KS •0077 •0260	OMEGA3**2 •1667+10 •8825+09	2ZETOM3 •2906+06 •1720+06	
XBAR .001 .002	.4809	•7041+09 •5117+09 •3929+09	.1148+06 .9011÷05 .7266+05	OMEGA2**2 •2809+10 •1496+10 •9843+09 •7980+09	2ZETOM2 •1390+06 •1041+06 •8281+05	KS •0077 •0260 •0509	OMEGA3**2 •1667+10 •8825+09 •5780+09	2ZETOM3 •2906+06 •1720+06 •1235+06	
XBAR .001 .002 .003	.0877 .2458 .4809	•7041+09 •5117+09 •3929+09	.1148+06 .9011÷05 .7266+05	0MEGA2**2 .2809+10 .1496+10 .9843+09 .7980+09	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05	KS	OMEGA3**2 •1667+10 •8825+09 •5780+09 •4053+09	2ZETOM3 •2906+06 •1720+06 •1235+06 •9933+05	
XBAR .001 .002 .003 .004 .005	KP •0877 •2458 •4809 •8589 1.4831	.7041+09 .5117+09 .3929+09 .3192+09	.1148+06 .9011+05 .7266+05 .6211+05	OMEGA2**2 •2809+10 •1496+10 •9843+09 •7980+09 •7557+09 •7917+09	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05 •6594+05	KS	0MEGA3**2 -1667+10 -8825+09 -5780+09 -4053+09 -2764+09	2ZETOM3 .2906+06 .1720+06 .1235+06 .9933+05 .8607+05	
XBAR .001 .002 .003 .004 .005	.0877 .2458 .4809 .8589 1.4831 2.4865	.7041+09 .5117+09 .3929+09 .3192+09 .2696+09 .2341+09	.1148+06 .9011+05 .7266+05 .6211+05 .5560+05	0MEGA2**2 .2809+10 .1496+10 .9843+09 .7980+09 .7557+09 .7917+09	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05 •6594+05 •6398+05	KS	0MEGA3**2 .1667+10 .8825+09 .5780+09 .4053+09 .2764+09 .1573+09	2ZETOM3 •2906+06 •1720+06 •1235+06 •9933+05 •8607+05	
XBAR .001 .002 .003 .004 .005 .006	.2458 .4809 .8589 1.4831 2.4865	.7041+09 .5117+09 .3929+09 .3192+09 .2696+09 .2341+09	.1148+06 .9011+05 .7266+05 .6211+05 .5560+05 .5143+05	OMEGA2**2 •2809+10 •1496+10 •9843+09 •7980+09 •7557+09 •7917+09 •9053+09 •1095+10	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05 •6594+05 •6398+05 •6517+05	KS	OMEGA3**2 .1667+10 .8825+09 .5780+09 .4053+09 .2764+09 .1573+09 .3581+08	2ZETOM3 .2906+06 .1720+06 .1235+06 .9933+05 .8607+05 .7770+05	
XBAR .001 .002 .003 .004 .005 .006 .007	.2458 .4809 .8589 1.4831 2.4865 4.1305 6.7240	.7041+09 .5117+09 .3929+09 .3192+09 .2696+09 .2341+09 .2089+09	.1148+06 .9011+05 .7266+05 .6211+05 .5560+05 .5143+05 .4896+05	0MEGA2**2 .2809+10 .1496+10 .9843+09 .7980+09 .7557+09 .7917+09 .9053+09 .1095+10 .1383+10	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05 •6594+05 •6398+05 •6517+05 •6909+05	KS	0MEGA3**2	2ZETOM3 .2906+06 .1720+06 .1235+06 .9933+05 .8607+05 .7770+05 .7347+05	
XBAR .001 .002 .003 .004 .005 .006 .007 .008	.2458 .4809 .8589 1.4831 2.4865 4.1305 6.7240 10.8700 17.5071	.7041+09 .5117+09 .3929+09 .3192+09 .2696+09 .2341+09 .2089+09 .1917+09	.1148+06 .9011+05 .7266+05 .6211+05 .5560+05 .5143+05 .4896+05 .4792+05	OMEGA2**2 .2809+10 .1496+10 .9843+09 .7980+09 .7557+09 .7917+09 .9053+09 .1095+10 .1383+10 .1804+10	2ZETOM2 •1390+06 •1041+06 •8281+05 •7147+05 •6594+05 •6398+05 •6517+05 •6909+05 •7575+05	KS	0MEGA3**2	2ZETOM3 .2916+06 .1720+06 .1235+06 .9933+05 .8607+05 .7770+05 .7347+05 .7128+05	
XBAR .001 .002 .003 .004 .005 .006 .007 .008 .009	.2458 .4809 .8589 1.4831 2.4865 4.1305 6.7240 10.8700 17.5071	.7041+09 .5117+09 .3929+09 .3192+09 .2696+09 .2341+09 .2089+09 .1917+09 .1797+09	.1148+06 .9011+05 .7266+05 .6211+05 .5560+05 .5143+05 .4896+05 .4792+05 .4781+05	OMEGA2**2 .2809+10 .1496+10 .9843+09 .7980+09 .7557+09 .7917+09 .9053+09 .1095+10 .1383+10 .1804+10 .2415+10	2ZETOM2	KS	0MEGA3**2	2ZETOM3 •2906+06 •1720+06 •1235+06 •9933+05 •8607+05 •7770+05 •7347+05 •7128+05 •7172+05	

			Alaskinski inga qariguya rasaa		The same of the Activities of the	- Adicipal Constitution of the Constitution of						
	****	and a great companies and an artist of the second	A .	derman dang gelekki kadalah di ka- at- sa mente								
	15.	232.5178	•1736+09	•645	1+05	.1040+11	•2305+06	10.73		2927+10	•1765+06	
•0	16	454.7057	.1835+09	•719	3+05	•1699+11	•3149÷06	18.57	709 -•	4422+10	.2481+06	
• 0	17 1	.027.6560	.1914+09	•795	9+05	.2978+11	•4635+06	33.99	930	7309+10	·3834+06	
	18 2	987 • 5216	.1827+09		7+05	•5478+11	•7611+06	67•66		1434+11	•6702+06	
INTERMEDIAT	E VA	LUES	and the second second second second							n auto a l'artina con l'estimanaire		
XBA	R	X	YC	SIN(PSI1)	ZCi	U	YS	SIN(PSI2)	ZS2			
• 0	01	•7169	.2133	.4003	•0259	•7550	.2133	•4228	.0055	and the second of the second o		
	02	.9543	3639	4014		1.0328		4373			· · · · · · · · · · · · · · · · · · ·	
•0	03	1.1507	.4966	•3843	•2486	1.2917	•4966	.4360	.0427			
• 0	04	1.2907	•5533	•3952	.4571	1.5842	• 5533	•4815	.0684			•
	05	1.3557			.7234	2,0399	5260	• 5898			anni province de la compa compani com proprieda de la compani com province de la companio del companio de la companio del la companio del companio de la companio del la companio del la companio de la companio de la companio de la companio del la companio de la companio del la companio de la companio del la companio	
•0	06	1.3476	.4511	.4870	1.0234	3.2538	.4511	•7505	.1107		•	
• (07	1.2827	•3588	•5347	1.3288	29.1295	•3588	•9291	.1234			
	08_	1.1870	2755	.5662	1.6196	-2.5936	2755	9951	1452			
• 0	109	1.0787	•2068	•58 05	1.8945	9868	•2068	8320	2053			
• (10	•9683	•1533	•5788	2.1630	5227	•1533	5922	3271			
	11		.1126	5638	2.4424	3182	.1126	4080	5272_			·
•0	12	•7602	.0821	•5380	2.7548	2102	.0821	2851	8304			•
• (13	•6669	.0593	•5046	3.1329	1473	.0593	2041	-1.2816		and the control of th	And the second second second second second
• (14	.5833			3.6247				-1.9631			
• 0	15	•5166	.0305	.4317	4.3200	~ •0829	.0305	1129	-3.0342			
• (16	•4895	.0230	•4189	5.4206	0695	.0230	0922	-4.8455		a commence de la comm	
• (17	5832	.0216	.4850	7.5675			0941	_ - 8.3673			
• (18	1.0390	.0310	•6987	13.9730	1043	•0310	1345	-17.8064			
STABILITY F	PARAI	METER					VIALUTE AT THE STREET					•
		. ,	WORK F	PER CYCLE								-
XB/	\R	CPC.	INLB	CPS, INLB	CP.	T. INLB						•

				- I was a second and the second		en e	and the second	Likelit Land Star for and Lot a	ovale orași
				The second of th				. The control of the	
	\$002	6.5080	•2067	6.7147	· · · · · · · · · · · · · · · · · · ·				
	.003	8.8931	•2606	9.1537		•		•	
	•004	11.0220	.3018	11.3238		THE RESIDENCE OF THE PROPERTY			
	005	13.0017	• 3385	13.3402	a april como a constituida a maistra como como proceso esta constituida de la como de la como de la como de la			armining in a second state of the second state	narradadores rais residênciados
	.006	14.1140	. •3535	14.4675					
	.007	14.0248	•3402	14.3650					
	800	12.8522	•3044	13,1567	Berner 1870 von dilleg von de mierope produkt illede hilde indek in de med in overlingen van de men	en die zu rieme i de konstent v. setzen dit er handelik friede			
	.009	11.1914	•2612	11.4526					
***************************************	.010	9•4967	•2209	9.7175		anning meningan meninggangga panggapaga yang yang beranggan meninggan meninggan peninggan beranggan peninggan			
	011	8.0205	1883	8.2088	and the second section of the second section of the second section of the second section of the second section			THE PARTY OF THE P	
	.012	6.8401	•1642	7.0043					
	.013	5.9672	•1484	6.1155	* * * * * * * * * * * * * * * * * * *				of the adolegoment of the section of
	.014	5.3808	•1402	5.5210	er og syn i sammende erende for er		annananan, ina ingga ar dang pengangan 6, 536, 146, 47 (1881 5 w		
	.015	5.1311	•1417	5.2728					
	.016	5.5190	•1631	5.6822	austari sais, ar fall-scalarias, saltralias escala returnativos retrost filosofias electro fair calminas alba massar I				······································
	017	7.9678	• 2570	8.2248					
	.018	18.6621	•6880	19.3500					
ROOTS								,	
	XBAR IN	ROOT S	IMAG	ROOT S2 REAL IMAG	ROOT REAL	S3 IMAG	ROOT REAL	S4 IMAG	
	.0010	6477+04	•0000	1106+06 .000	002454+05	•0000	1145+06	•0000	
	.0020	6065+04	.0000	8533+05000	1723+05	•0000	8682+05	•0000	
	.0030	5856+04	•0000	6760+05 .000	1439+05	•0000	6842+05	•0000	
· · · · · · · · · · · · · · · · · · ·	.0040	5618+04	•0000	5704+05 .000	001385+05	•0000	 5762+05	•0000	
	.0050	5319+04	.0000	5070+05000	00	<u> </u>	5117+05	•0000	
	.0060	4985+04	•0000	4678+05 .000	1677+05	•0000	4722+05	•0000	
	•0070	4636+04	•0000	4461+05 .000	002008+05	•0000	4510+05	•0000	May 11
	0080	-,4296+04	•0000	4388+05,000	2462+05	•0000	4447+05	•0000	
	•0090	3973+04	•0000	4408+05 .000	003073+05	•0000	4502+05	.0000	•

TO SHARE THE PROPERTY OF THE PARTY OF THE PA	went was a state of the state o		l				alah aran dari dari dari dari dari dari dari dari	and the second	A STATE OF THE PARTY OF THE PAR
						and the second section of the	Marie Control of the Control of the Control	CONTROL OF STREET	and the second s
.0100	3670+04	•0000	4505+05	.0000	3817+05	•0000	4726+05	.0000	
.0110	3388+04	•0000	4674+05	.0000	4417+05	•0000	5467+05	.0000	e an element to t
.0120		•0000	_ - .4920+05		4773+05		6944+05		
.0130	2880+04	•0000	5260+05	•0000	5138+05	•0000	9108+05	•0000	
.0140	2646+04	.0000	5707+05	•0000	5585+05	•0000	1222+06	•0000	The second control of the second seco
0150	2421+04	•0000	- .6287+05	0000	6150+05		1690+06	•0000	
.0160	2195+04	•0000	7081+05	.0000	6915+05	•0000	2457+06	•0000	
.0170	1949+04	•0000	7914+05	.0000	7704+05	•0000	 3865+06	•0000	
0180	1605+04	•0000	8316+05		8048+05	0000		0000	
ROOT LOCUS MET	HOD	-		*************		and the second s		y an employment of the employment developed a	
XBAR IN	ROOT LOCUS GAIN	N BODIE PLOT K. 1/S*		G OPEN OP KGH1	OMCRO: RAD/SEC	PHASE MARGIN PHIM DEG		·	· · · · · · · · · · · · · · · · · · ·
.001	.48604+08	•12397+08	1.	0015	3761.5641	21.4957			
.002	63319+08	.21901+08	1.	0054	5249.8405	23.9971			
207									
•003	•73770+08	•29668+08	1.	0066	6297.1318	23.5024			
•004	.73770+08	•29668+08 •33882+08		9923	6297•1318 6972•4957	23.5024			
			•						
•004	•84371+08	•33882+08		9923	6972•4957	24.4881			
.004	.84371+08 .95197+08	•33882+08 •33972+08	1.	9923	6972.4957	24.4881 27.5699			
.004 .005 .006	.84371+08 .95197+08 .10461+09	•33882+08 •33972+08 •30813+08	1.	9923 .0087	6972.4957 7120.3950 7048.3027	24.4881 27.5699 32.0087			
.004 .005 .006	.84371+08 .95197+08 .10461+09	.33882+08 .33972+08 .30813+08	1.	9923 .0087 .9904	6972.4957 7120.3950 7048.3027 6556.5781	24.4881 27.5699 32.0087 36.7374			
.004 .005 .006 .007	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09	.33882+08 .33972+08 .30813+08 .25958+08	1.	9923 0087 9904 9944	6972.4957 	24.4881 27.5699 32.0087 36.7374 40.4545			
.004 .005 .006 .007 .008	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09 .12648+09	.33882+08 .33972+08 .30813+08 .25958+08 .20762+08 .16015+08	1.	9923 .0087 .9904 .9944 .9960	6972.4957 7120.3950 7048.3027 6556.5781 5856.0737 5023.5977	24.4881 27.5699 32.0087 36.7374 40.4545 42.5077			
.004 .005 .006 .007 .008 .009	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09 .12648+09	.33882+08 .33972+08 .30813+08 .25958+08 .20762+08 .16015+08	1.	9923 0087 9904 9944 9960 0099	6972.4957 7120.3950 7048.3027 6556.5781 5856.0737 5023.5977 4309.3022	24.4881 27.5699 32.0087 36.7374 40.4545 42.5077 43.3900			
.004 .005 .006 .007 .008 .009	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09 .12648+09 .13126+09	.33882+08 .33972+08 .30813+08 .25958+08 .20762+08 .16015+08 .12033+08	1.	9923 .0087 .9904 .9944 .9960 .0099 .9935	6972.4957 7120.3950 7048.3027 6556.5781 5856.0737 5023.5977 4309.3022	24.4881 27.5699 32.0087 36.7374 40.4545 42.5077 43.3900 42.7428			
.004 .005 .006 .007 .008 .009 .010	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09 .12648+09 .13126+09 .13504+09	.33882+08 .33972+08 .30813+08 .25958+08 .20762+08 .16015+08 .12033+08 .88573+07	1.	9923 0087 9904 9944 9960 0099 9935 9928 0029	6972.4957 7120.3950 7048.3027 6556.5781 5856.0737 5023.5977 4309.3022 3604.5788 2963.6966	24.4881 27.5699 32.0087 36.7374 40.4545 42.5077 43.3900 42.7428 40.9274			
.004 .005 .006 .007 .008 .009 .010 .011 .012	.84371+08 .95197+08 .10461+09 .11362+09 .12058+09 .12648+09 .13126+09 .13504+09 .13792+09	.33882+08 .33972+08 .30813+08 .25958+08 .20762+08 .16015+08 .12033+08 .88573+07 .63988+07	1.	9923 .0087 .9904 .9944 .9960 .0099 .9935 .9928 .0029	6972.4957 7120.3950 7048.3027 6556.5781 5856.0737 5023.5977 4309.3022 3604.5788 2963.6966 2423.1989	24.4881 27.5699 32.0087 36.7374 40.4545 42.5077 43.3900 42.7428 40.9274 38.4935			

	e e cej moderni i de mendendi.							
	•13220+09	•32207+06	1.0034	584.4755	19.9504			No or state was a first own and statement of any lateral.
-		190 St 190 Lt A	OF STREET STREET, ST. T. T. T. ST. S.					
RESPONSE								
XBAR IN	FREQU RESP AMPL	STEP RESP AMPL	DAMPING ZETA	SETTLING TIME IS. SEC	1			
.001	2.7290	1.5509	•186	•006			tida a di seri dali degli mpatikating terbanya menganya menganjah di seri dali di selah di selah menganya meng	
•002	2•4589	1.5130						
.003	2.5076	1.5203	•204	•003				
.004	2.4125	1.5058	.212	•003		APP - Pr Service APP - THE THIRD THE TRANSMISSION AND	- C V. V	
.005	2.1606	1.4627	•238	.002				
•006	1.8866	1.4062	•276	•002				
007	1.6718	1.3524	•315	•002				
800.	1.5412	1.3143		002				
•009	1.4800	1.2947	•362	•002				
•010	1.4557	1.2866	•370	•003				
.011	1.4734	1.2926	.364	.003				
.012	1.5265	1.3097	•350	•004				
•013	1.6066	1.3340	•330	•005				
014	1.7137	1.3637	.306	•007				
•015	1.8619	1.4005	•280	•009				
•016	2.0714	1.4456	•249	.013			· · · · · · · · · · · · · · · · · · ·	
	2.3947	1.5030	.214	.021				
.018	2.9308	1.5756	•173	.040				

DATA CARDS IGNORED - FIRST IS LISTED BELOW

3. CIRCULAR CROSS SECTION VOLUTE DESIGN

COMPUTER PROGRAM

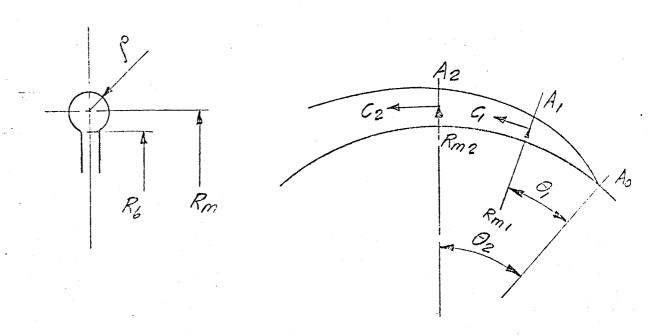
CIRCULAR CROSS SECTION VOLUTE DESIGN

I. INTRODUCTION

This program presents an incremental method for the design of a classical pump volute with circular cross-sections which are tangent to the volute base circle. Volute area distributions as well as velocity and pressure distributions are calculated and printed out.

This program was primarily devised to determine the percentage increase in cross-sectional area required for the compensation of friction losses in the NERVA turbopump volute which is discussed in Reference 1.

II. BASIC EQUATIONS



Reference 1 - Aerojet Nuclear Systems Company Engineering Operations Report
N8300R:71-076, NERVA Turbopump Design Report, Volume 1, 24
September 1971

The flow rate V in the volute is assumed to be proportional to the wrap angle θ (no back flow, zero cut water clearance flow).

The volute cross sectional area A_2 at the wrap angle θ_2 can then be calculated from the total flow at the volute throat V_{th} .

$$A_2 = \frac{\theta_2}{2\Pi} \quad \frac{V_{th}}{C_2} = \Pi \rho_2^2 \tag{1}$$

Assuming constant moment of momentum:

$$R_{m1} C_1 = R_{m2} C_2 = K$$

where:

$$R_{m2} = R_6 + \rho_2$$

Thus:

$$c_2 = \frac{K}{R_{m2}} = \frac{K}{R_6 + \rho_2}$$
 (2)

Substituting C_2 in (1)

$$A_2 = \frac{\theta_2 V_{\text{th}}}{2\Pi} \qquad \frac{R_6 + \rho_2}{K} = \Pi \rho^2$$

Solving for ρ the quadratic equation can be written as follows:

$$\rho^2 - \frac{\theta_2 V_{th}}{2\Pi^2 K} \rho - \frac{\theta_2 V_{th}}{2\Pi^2 K} R_6 = 0$$

Let

$$\frac{\theta_2 V_{th}}{2\pi^2 K} = Y$$

then:

$$\rho^2 - Y\rho - YR_6 = 0$$

and

$$\rho = \frac{Y + \sqrt{Y^2 + 4 Y R_6}}{2}$$

Friction losses are calculated for the mean cross section of a volute increment:

$$A_{m} = \frac{A_{1} + A_{2}}{2}$$

$$\rho_{\rm m} = \left(\frac{A_{\rm m}}{\Pi}\right)^{0.5}$$

Length of volute increment:

$$L_{\rm m} = \Delta \theta R_{\rm m}$$

The friction coefficient is based on the relative surface finish and the empirical relationship established by Nicuradse (Reference 2).

$$\lambda = \frac{1}{(.8685 \ln (\frac{\rho_{\text{m}}}{f_{\text{s}}}) + 1.74)^2}$$

Friction loss for volute increment

$$\Delta H_{\text{fric}} = \lambda \frac{L_{\text{m}}}{2\rho_{\text{m}}} \frac{C_{\text{m}}^2}{2 \text{ g}}$$

The friction loss is recuperated by an increase in diffusion

$$\Delta H_{fric} = \Delta H_{vel}$$

which is achieved by a decrease in velocity or respectively, an increase in area.

Reference 2 - Eckert/Schnell, Axial and Radial Kompressoren, Springer-Verlag 1961

$$\Delta H_{\text{vel}} = \frac{c_2^2}{2 \text{ g}} - \frac{c_{2c}^2}{2 \text{ g}}$$

where $\rm C_{2c}$ is the lowered velocity corresponding to the increased or corrected area $\rm A_{2c}.$ From continuity:

$$C_{2} A_{2} = C_{2c} A_{2c}$$

$$\Delta H_{fric} = \frac{C_{2}^{2}}{2 g} \left(1 - \left(\frac{C_{2c}}{C_{2}}\right)^{2}\right) = \frac{C_{2}^{2}}{2 g} \left(1 - \left(\frac{A_{2}}{A_{2c}}\right)^{2}\right)$$

From this expression the corrected area A_{2c} is:

$$A_{2c} = \frac{A_2}{(1 - \frac{2 g \Delta H_{fric}}{C_2})^{0.5}}$$

NOMECLATURE

INPUT

111111111111111	68999999999	555555555555	444444	۵ ۵ ۵ ۵ ۲ ۵ ۵	22222222222222	00000000000000000000000000000000000000	124 44 60	INPUT FORMAT	B5	NUM	SFS	DL	PSEX	OMEG	RHO	QD	ALP6	SYMBOL R6
ווווווו וווווווווווווווווווווווווווווו	6 និ	555555555555555555555555555555555555555			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5 60 60 60 60 60 60 60 60 60 60 60 60 60	0. 4.45 0.20 1580. 4.75		Port Width at Base Circle	Number of Increments	Surface Finish	Exit Diffuser Discharge Diameter	Exit Pressure, Static	Exit Diffuser Loss Coefficient	Fluid Density	Flow Rate	Fluid Angle at Base Circle	DESCRIPTION Radius, Base Circle
111111111111	8 8 8 8 8 8 8 8 8	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	ມ ມ ມ ມ	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		1255-03 35 B	• • • • • • • • • • • • • • • • • • • •	In	ı	In	In	psi	(0.20)	lb/cu ft	gpm	Deg	In
1111111111	8 8 8 8 8 8 8	5 5 5 5 5 5 5 5 5	44444444	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	000000000000000000000000000000000000000	0.500		71	H	m	71	-11 .	, -11	-TT	- 11	, '''1	FORMAT

	TOBLAL CLUMATANO
Belling a record of the second of the company company of the second of t	((I-I)A + (I)A)*3.0 = MA
	$\forall \forall $
	IJ C(1) = VD(1) VA(1)
	(1)A = YATZ
	S**(1) = 3*16194 * 691*1 * 2*1
	RAD(1) = (CUNST + SORT(CONST**2 + 4. * CDNST * R6))/2.
	CONST = VD(1)\(3.14159 + RXC)
	(DX8 * 02141.51/11/04.7.11/00.
•	BXC = (BVD(1-1) + BC) * C(1-1)
) = N 09
	5 = 1
	HFR(1) = 0 .
•	EBIC(1) = 0
	HAEF(1) = C(1)**5\00000000000000000000000000000000000
,	C(I) = CN(I)
	AAD(1) = RADN(1)
	(1) NA = (1)A
	SO $CN(1) = AD(1) V V CN(1)$
·	VD(1) = THEI(1)/360. # VDT
	ANC(1) = 3.14159 * RADN(1)**2
•	BYDN(I) = IHEI(I)\CADE + SOBI(S**B6 * THEI(I)\CADE)
	WON-1=1 07 00
	1 THE ((1) = (1-1) 1 HE ((1-1) 1 HE (1-1) 1 HE (1) 1 HE (
	OO 10 1=5.00M
	1110 = (1)1301
•	
	CVDL = 360. * COS(ALPR6)\(BS * SIN(ALPR6))
	865.√2\39d⊿ = 3Hq_A
	V01 = 0.321 * 00
	MUN/.03E = 1H1Q .
	. MBILE(FM*8) DF*2E2*NOW*82
* ************************************	(9*M) 33. (19*M)
The second secon	WRITE(LW.7) R6.ALP6.0D.RHD.0MEG.PSEX
	MULE(FM*2)
	M011E(FM*0)
	(7-11-11-11-11-11-11-11-11-11-11-11-11-11
•	11 WRITE (LW.1)
	11 (86) 500.500.01
	6 REVD(FR'3) R6.ALG6.00.RHD.QMEG.PSEX.DL.SFS.NUM.BS
	B FORMAT(5X,F15.3,E15.3,115,F15.3A/)
· · · · · · · · · · · · · · · · · · ·	7 FURMAT(5X.6F15.3//)
	6 FORMAT(15X, DLINE . 10X, 'SFS' . 13X, 'NUM . 13X, '85' \)
	(\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
	S FORMAT(16X, R6. 12X, ALP6. 12X, RD. 14X, RHO. 13X, OMEG. 12X, PSEX
	(\\\\ +++
	ε (ε.θ٩٠٤) τΑΜΝΟ Ε
	2 FORMAT(42X, VULUTE VELOCITIES + PRESSURE DISTRIBUTION . V.)
	1 FOUMAT(*1*)
	S = M7
	2 = 87
	1C(60), HVEL(90), FRIC(90), HFR(90), PS(90), HFRT(90)
	University of the Control of the Control of the Control of Control
	LIST ALL DIMENSION THET(90), RADN(90), ANC(90), VD(90), CN(90), A(90), RAD(90).
	TOCS(CARD, TYPEWRITER, KEYBOARD, 1403 PRINTER, DISK)
	V F08
·	
	S MOS ACTUAL 16K CONFIG 16K
	0000 0001 0001
	0000
The same are a second of the same and the sa	DO DRIVE CART SPEC CART AVAIL PHY DRIVE
	1 800 //

....

.....

. ...

	A(R)=0436-0384 PS_KR)=0832-0780 NPEG(R)=08FC VDT(R)=0908	CA-0618 HFR(R)=077E-06CC CA-0618 CA-0	=08E6 05(R)=08 =08E6 350=08		#####################################
	•				e or op 9012 002
				: ; :X TEX ,	MATTE(LW,120) PH WATTE(LW,121) PH WATTE(LW,121) PH WATTE(LW,120) PH WATTE(LW,120) PH
	·		(\sisq:\xs.e.89.*=	AL DISCHARGE PRESSURE ESCHELLOSER	124 FORWAT(20X, PRE
			######################################	CTION LOSS INCL EXIT DIFFUSER	122 FURMATICZOX, EXI
			T4.*X2.E.83.2X.*FT	FRICTION LOSS VOLUTE	
			31C(1)*HEBI(1)*BS(1)*1	нЕТ (1)Э.(1)ДАЯ.(1)ИДАЯ.(1)ТЭНТ	*** ** *
			/er.,12x,'FR1C',10x;	<mark>/*,1</mark> 0X, 18NC 1,11X, 18CÜR 1,10X, 1	101 F08MAT(\\\\S3x, ThET 102 E08MAT(\X, 102, ThET 103, 103, 103, 103, 103, 103, 103, 103,
					MUN-1=1 07 00
	•		·		DIEX = AEX##5VQ
,				5 + DWEC+HAET(NOW) AET(NOW)+BHOVI¢¢*	
	·	*			0 = (1) 89 H 0
	· · · · · · · · · · · · · · · · · · ·				40 1 = 1+1; co 10 = 0 42 continue
				75 ° 45	
	•			- HAEF(I) + HEB(I))\S*	
		V.		L(1*-HEB(I)\HAEF(I))	30 SAFE = HVEL(1) STA = YATS (1) = YATS (1) A SE
	1	ti valt meditin della 1 (min 1987) como signi della dell'estada (chi) e della supplica (chi. chi. chia	,	*S\P**7¢B) *XFW * CW**S\(158*989\$*80W	TE(N) 30*30*35
•				1-1))\s-	КМ = R6 + RAEM КМ = R6 + RAEM СМ = (C(I) + C(
•	•				a = 35¥0

		1	EX	Sd	OMEG	она	go.	9d 1A	, u	
				1290*000	005.0	05 5*	6230+000	14*300	000•8 ?ä	
		•			and the second of the second o	58	MUN	SBS	DETNE	
				po afficiar de alban per per propos com como de com per	.,	009•0	9F	0-125E-03	091.4	
							and the second s	 		
			<u>, </u>	en e		** 104100 ***	a manifest of a particular particular database pages of controlly and a contribution basis for a set of			
			<u> </u>			104100 ***	antino, es ar ario de después pointe esta artes en un mantino.	and the second s		
			Sq	1934	EBIC I	VEL	всов	вис	ATBHI	
			£618.2321	0000*0	0000*0	59198666	6 4 9 2 * 0	6495*0	0000*01	
			6649*9951	29.4864	SE10*0	244.5606	0.3802	2772.0	20,000	
			1567,2529	5856.64	0.0128	739.2457	8074.0	£999°0	30.000	
			6077.4321	8166*59	0.0124	234.9321	9875*0	4485.0	. 0000 * 0 *	
			1208*255 <u></u> 1208*1200	6961*64	1210.0	231.2430	6819.0	0.6062	0000 • 05	
			8678*8991	0765*06	8110-0	6886.755	1389.0	1949.0	0000.03	
			1291°6951	8689*601 8619*001	9110*0	\$52°0203	91740	2617.0	0000.07	
			9124.6991	9417.711	\$110*0 	222,3829		£144.0	60.0000	
			9976,6481	125,1567	0.0112	219,9113	9058*0	0.8203	0000.00	
			1209,9123	1921.0197	1110.0	2,004,212	\$106°0	6998*0	0000.001	
			2461.0781	128.1931	0.110	213°4148	1096*0	#116*0	0000*011	
			1570,3442	9006.001	6010*9	511*4904	1266*0	1796*0	150.0000	
			1570.5427	149.9283	H010.0	500*653	9980*1 1*0452	\$266.0	0000.001	
			Sitr.orai	1891*991	7010.0	6100.705	1.1295	6750*1	0000.091	
			9016.0781	19011903	9010*0	206.2267	2171.1	9011°1	0000°091	
			1571,0820	1948.491	9010.0	204.6192	1.2120	1741.1	170.000	
			1571.2460	1109.3560	5010.0	£670.20S	1.2519	1.1825	190,000	
		•	2504.1721	6059*541	9010.0	201-5836	1.2909	1715.1	0000.001	
			6999*1491	177.7126	4010.0	200.1453	1.3292	1.2509	200,000	
			5007.1781	£619.181	7010°0	5457.861	8998*1	1.2339	210,0000	
	÷		8178,1721 8379,1721	559£ • 581	£010.0	9407*461	1504.1	1*3163	220.0000	
			6201.5781	188*9636	5010.0	7101.961	1077.1	1.3480	210.0000	
			1672.2348	£857.261	0.0102	£££8*761	8517.1	167E.1	240.0000	
	•		6725.3721	9579,891	0.0101 0.0101	9009*601	0115*1	2605°1	520.000	
			_ OTT A.STZI	5870.505	1010.0	192.4013	1898.1	966+*1	500.000	
			1572,5930	3670.205	0010*0	191,2331	0095*1	\$69 * 1	270,0000	
			1572,7055	8589.405	00100	\$686*88\$	8513.1	5864.1	540.0000	
	,		6218.5721	696T.01S	0010.0	9868.781	1.6472	1758.1	0000.645	
٠.	***		1572,9213					\$555 *1	0000.001	
٠.			1572,0213	213.5241 216.1704	6600°0	7858.281 5208.281	8517.1 0247.1	1*2438	60(0.01)	

•	
	, o
•	
ISC	PRESSURE LUSS, EXIT UTFFUSER = 3,176
,	EXIT VELOCITY = 1124911 TOTAL DISCHARGE PRESSURE =1586.122
	FRICTION LOSS INCL EXIT DIFFUSER = 328.834
	FRICTION LOSS VOLUTE = 226.028

4. INDUCER AND IMPELLER PERFORMANCE PROGRAM

COMPUTER PROGRAM

INDUCER AND IMPELLER PERFORMANCE PROGRAM

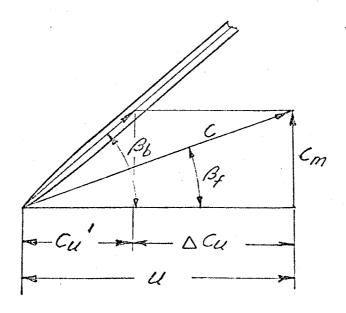
I. INTRODUCTION

A detailed loss analysis calculating incidence, friction, diffusion, discharge, blade clearance and labyrinth flow losses of inducers and impellers of arbitrary geometry is presented. Actual and ideal head coefficients, efficiency and power losses resulting from disk friction are printed out.

II. BASIC CALCULATIONS

A. Incidence Losses

It is assumed that a specified percentage of the velocity head based on the difference in tangential velocity component $\Delta Cu_{\underline{m}}$ is lost.



$$\Delta Cu = C_{m} (Cot \beta_{f} - Cot \beta_{b})$$

If $K_{\underline{i}}$ is the incidence loss factor based on the inlet mean diameter, the incidence loss is:

$$\Delta \psi_{\text{li}} = \frac{K_{i} \frac{\left(C_{\text{m}}(\cot \beta_{f} - \cot \beta_{b})\right)^{2}}{2g}}{\frac{U^{2}}{\text{where:}} \phi = \frac{C_{\text{m}}}{u} \frac{U^{2}}{u} \text{ (inlet)}^{g}} = \frac{K_{i}}{2} \left[\phi \left(\cot \beta_{f} - \cot \beta_{b}\right)\right]^{2}$$

The value $\frac{R_1}{2}$ used in this program is 0.15 (program constant). Program evaluations have indicated that the incidence loss so calculated is generally excessive, especially for radial impellers with diameter ratios, R_1/R_2 lower than 0.55. It would be advisable to modify above expression to include consideration of the diameter ratio (e.g. $(U_{1m}/U_{2m})^2$).

B. Friction Losses

Friction losses are based on the mean relative velocity, the hydraulic diameter of the blade passage and the blade surface finish. If not input the friction coefficient for Reynolds numbers greater than 10^5 is determined according to Reference 1:

$$\lambda = \frac{1}{(.8685 \, 1_{\rm n} \, (d_{\rm h}/2 \, f_{\rm s}) + 1.74)^2}$$

For laminar flow, ${\rm Re} < {10}^5$, the friction coefficient is calculated according to the following expression derived by Blasius:

$$\lambda = .0032 + \frac{0.221}{R_e^{0.237}}$$

Reference 1 - Eckert/Schnell, Axial and Radial Compressors, Springer 1961

C. Diffusion Loss

The diffusion loss is related to the diffusion parameter $\mathbf{D}_{\mathbf{I}}$

$$D_{I} = 1 - \frac{W_{2}}{W_{1b}} + \frac{W_{u2} - W_{u1}}{2 \sigma W_{1b}}$$

where:

W₂ = relative velocity, discharge

 W_{1b} = relative velocity, inlet blade passage

 W_{u2} , W_{u1} = tangential components of relative velocities

 σ = solidity

The diffusion loss coefficient is:

$$\Delta \psi_{\ell,d} = 0.08 D_{I}^{3}$$

D. Tip or Exit Losses

This loss is very small and generally neglected.

$$\Delta \psi_{\ell,t} = .5 \left(\frac{\phi_2}{BLK2} \right)^2$$

 ϕ_2 = discharge flow coefficient

BLK2 = impeller discharge blade blockage

E. Clearance Losses

Blade tip clearance losses are related to blade loading, tip clearance and fluid viscosity. The expressions listed in subroutine ILOSS

for estimating clearance losses yield reasonable values for swept back blading operating in water as liquid nitorgen. Loss coefficients for radial blading ($\beta_2 = 90^{\circ}$) in liquid hydrogen calculated by the same method were found to be excessive.

F. Blade Losses

The summation of above losses constitute the blade losses.

$$\Delta \psi_{\ell,b} = \Delta \psi_{\ell,i} + \Delta \psi_{\ell,f} + \Delta \psi_{\ell,d} + \Delta \psi_{\ell,t} + \Delta \psi_{\ell,c}$$

G. Labyrinth Clearance Losses

The labyrinth clearance flow is estimated using semiempirical equations devised by G. Vermes. Reference 2. The annular
orifice flow coefficient is calculated from data presented in Reference 3.
Data interpolation is performed by subroutine INT4.

H. Disc Friction Losses

The disc friction losses are computed using friction coefficients based on Schultz & Grunow's data published in Reference 4. Backvane power losses are estimated according to Reference 5.

- Reference 2 Geza Vermes, A Fluid Mechanics Approach to the Labyrinth Seal Leakage Problem, Journal of Engineering for Power, April 1961
- Reference 3 K. H. Bell & O. P Bergelin, Flow Through Annular Orifices, TRANS. ASME, Vol. 7, 1957
- Reference 4 A. J. Stepanoff, Centrifugal and Axial Flow Pumps, J. Wiley & Sons, 1957
- Reference 5 K. T. Zanker, Experiments With Badvanes Used for Balancing Axial Thrust on Centrifugal Pump Impeller; The British Hydromechanics Research Association, RR 729, April 1962

I. Slip Factor

The slip factor // for the determination of the theoretical head is calculated according to Reference 6 as follows:

$$\frac{1}{1 + \psi' \frac{R_2^2}{ZM_s}}$$

where:

 ψ' = experience factor (see instructions)

 M_s = static moment of impeller blade = 1/2 ($R_2^2 - R_1^2$) for radial blades

Z = number of impeller blades

Reference 6: G. Pfleiderer, Die Kreiselpumpen, 5th Edition, Springer Verlag, 1961

III. GENERAL INSTRUCTIONS

A. A negative value in place of the blade tip clearance SCL will cause the program to calculate a tip clearance related to the discharge diameter of the impeller.

The program flags FLAG and IFLAG select the configuration.

FLAG

 Value (Real)
 Configuration

 Negative
 Unshrouded with backvanes

 Zero
 Unshrouded, smooth

 Positive
 Shrouded, smooth

 IFLAG

 Value (Integer)
 Configuration

 Zero
 Impeller (will calculate disc friction)

Positive Inducer (Will not calculate disc friction)

B. Values for Pfleiderer's experience factor FSLIP for slip depend on pump configuration and impeller blade discharge angle β_2 .

If the impeller discharges into a vaned diffuser:

FSLIP = 0.6
$$(1 + \frac{\beta_2}{60})$$

If a volute housing is used only:

FSLIP = (0.65 to 0.85)
$$(1 + \frac{\beta_2}{60})$$

If a vaneless diffuser is used in conjunction with a collector: FSLIP = (0.85 to 1.0) $(1 + \frac{\beta_2}{60})$

- C. The blade chord length CLBL must be determined from layout.

 The blade solidity is obtained by dividing the blade chord length by the mean blade spacing.
- D. For shrouded impellers, an initial or starting value for the labyrinth flow must be input. The correct value is calculated by iterations.

NOMENCLATURE INPUT

SYMBOL	DESCRIPTION	UNITS	FORMAT
BB2	Discharge Blade Angle	Deg	F
Z	Blade Number	pod mpd	F
SM	Stat. Moment of Blade	IN ²	F
WIMP	Impeller Flow Rate	lb/sec	F
BBMI	Inlet Mean Blade Angle	Deg	F
BBTI	Inlet Tip Blade Angle	Deg	F
ETIP	Total Pinbladed Tip Width, Shroud and Disc	IN	F
AFLIM	Inlet Mean Fluid Angle	Deg	F
D2	Discharge Diameter	IN	F
B2	Discharge Blade Width	IN	F
LLBL	Blade Chord Length	IN	F
*SCL	Blade Tip Clearance	IN	F
BLKZ	Discharge Blockage	%	F
RHØ	Weight Density	1b/sec	F
SOL	Blade Solidity	dead made	F
DTI	Inlet Tip Diameter	IN	F
DR	Radial Extension	IN	F
DHI	Inlet Hub Diameter	IN	F
XN	Rotating Speed	RPM	\mathbf{F}
*FLAG	Program Flag, See Instructions		F
VIS	Dynamic Viscosity	lb sec/ft ²	E
*IFLAG	Program Flag, See Instructions		I
ESHR	Axial Length of Labyrinth	•	F
SFFS	Surface Finish	IN	E
D	Labyrinth Diameter	IN	F
CO	Radial Clearance Labyrinth	IN	F
SNTH	Number of Labyrinth Teeth		\mathbf{F}_{-}
PI	Tooth Pitch	IN	F
T	Tooth Thickness	IN	F
XKDF	Disc Friction Factor		E
FSLIP	Pfleiderers' Experience Factor for S	LIP	F

^{*}See general instructions, Page 6.

ORIFICE DATA

on following page. These four cards must proceed regular input presented

								11: 6						W.	· ` ` • .	 . 6		*
.,	10		67)	4.5	~	***	7			,	_ ; _ ;	1,5		- ()		~ =		[
<u>ب</u>	•	-		5	^	دب	2 2					•				u c		Ë
	~	~	ണ	4.0	-	در س	2 2	ت سے دے شہ						- · ·				<u>}</u> .
دت			en en	<u>ي</u>	~	1	2	v. C3	•		tr C3			- v =	i			i i
	C-D		e,	ر ن	5-		~				17 CD				i			1
	C-3		m	ů.		. •	~		5,			1	1					
	2.77		177	-	-	:	~>		•				1 1 # 1				-	
ري	. 17	~	1-2	(.)	5-a 2-a	w	~			for Or	- : 0		Ŭ,			a 223		(F)
7.3	m .	~~	37	٠v	200	ترو	~	- 2 0	,	• • •	- : C		•	: E		: 63		1.
.29	4.17		(2)	(Jr	*	د.،	2 2	- 5 G			;; co			;; c=		; ==		Ē
	(31	-	er CT	\$ 3	E	4.3	2 2	- 7.00			i5 -=		1	- : -				Ë.
	c A.S Cars	_	ст Ст	S			~3	 ≠ ==			;; co			= ==		7 40		1
	c)	_	c.rs	Ç,		. 3333333333	~>	1111 0 0 0 0 0 0			1 1 0 0			;; cs		1 5 6		
	cos	~~	· 😁	en.	*	w	2 2	→ 55 ←			- : -	3	ψ	3 to		- : :		ŧ
ب	LUC.	_	¢n.	S	-	•	~			Ţ,	- 40		F 1	u, a,		mus a. 👄		part &
d)	7 0		====	டு	-	دے	7 7				- : =		00	23 1		0000		• *
ھت	23	~	en en	5 5	~		2 2	- 22	17.1	<u> </u>	30		Jane	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Ch.	D ==		{X }
-5	•	~	€ G.1		~		~	<u>~</u> co			~~ ; c⊃	•		→ ½ ⇔		1:		ŀ.
G)	20 20 20 CO			ټ	-	-	~	11111 0000 0000 0000			- : -			111111 222226 2000				· [:.
<u>د</u>	ULD.	_	m	5	-	w	~	2			1 2 0 0			23 25 E	•:	- 3 0		į.
	577	-	د. ۲	~	_	•••	~							- 3 - 5		_ ;; =		
<u></u>	- 243	-	c.s	ح	~	مب	~			2	- ; =			(* FE)	•	- i; -		;
~~	763 753 00	-	57	5		4.3	~	— % cm		σv.	- 2 =		(4)	64	•	- :: 0 - :: 0		- Jane 1
us us	CO.	~	22				~	27.72			22 0			- 3:	(0)	- ∷ ⇔	1	
 5:3	523	_	ου ου	5	3644646666644644646	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	~	- 3 5		T.	2 10		in in	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	. 002	1 1 1 1		901
L.A	000	~~		S	-	w	~	; ; ; ;			g ca		. مديد	- 50	i Dir	- 50		
	co	~	0 5	55555555555	~	e	2221212121112	11111111111111111111111111111111111111			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			- 20		- 2 6 '		Į
43	c.J	-	-	er.	**		~،	- 50			- 5 m			- 2 - 2		- ;; =		-
ō.	CC	-	~	c.		્રા યા કો જો સામ	~	- 20			- 26			x co ,); C		
1>	50	~	G,	. • •	· ~		. / 2	- 5 -			- u =			· 는 는		- 200		Į.
	00	_	٠. ص		- 4-			x c=			- x =			. •• x c= .	l'a			į.
9	07s	~	in.			٠. د.، "	أحرر أ	- u -			- 20	-	: .c. m: :	ter	© 00	EC. 13 E.		9
5			(m	C.P.	- 44	်) မော်	A 1-2	- 3 - 3		00 (2)	- : -		253.	at "" tg es	*TD	0000	2-2	r. i
. جي	2	~	ς.	: 23	4.4		, r.,	tg es	72	<u>"</u> _ :	- 5 - 5		(3)	5 G	5 11	- 8 6		
ت	co	~	د.،		<i>4.</i> ,		F.3.	- 5 C			1 1 1 1 1 2 4 4 6 3 6 6 9				1,00	-:-		
	~	-	e.	ا من	بدائر معاند	دن نب	1.0	11111						: ==		: - :		ĺ.
ن ت	60 60	~	cn	، ادر احره :			. 10	- 3 -			- : -			: -		1111		1
5	no.	_	67	101		د ا		- : c			- : 0			: 		-:0		Ì
45	S		c ₂	. 65	444			# C		•	→ ‡ ⇔			5 cs		- 60		F.
C.	0)		တာ	1 523	<i>i</i> ~	ب سه	نحا	- * C		السو	- 50	221	- X	- 21	- 1.4 c	îma n e		j #
S	œ	~	c	#L+3 -		w	ب	_ # E		-	- 4 60		ma	- 61 L - 6 G - 6 G	}		*****	
÷	con	~~	3	ىن		س	. ~	- 60	::.		- : =		430	3 G3 3 G3	1	- : O		7.73
رص	27.T	_	ຕາ	٠. د		 	~ ?	11111111 53 55 55 55 55 55 55 55 55 55 55 55 55 5			11111111111111 8666666666666		(5)	 ଓ⇔	្រោ	- 600 - 600 - 600 - 600		
-50	CO		on	cr	-	دسه	~	⊸ 5 co	,		· · ·	,	_	1: 0		- : 0		- 5
٤.,	600	~	හ භ භ	S	4-	æ	~	- :; e>		٠.	1 1 5 50 0 0					_ :: =		£
	60	~	c.	5 5	-	w	~	- 5 =			- * C			- Y 63		- 4 -		
CE	00	~	en en	5 5	~	•		1º CO		,	i					· :5 ==		ŀ
جب '	က	~	9		-	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	277777 77777777777777777777777777777777	- % -			X: C		1	0000 00 88989999999999999999999999999999		111111111111111111111111111111111111111		Ĭ
ردب ا	C13	~	cr.	ر. ب		w	. ,	- · · ·		1.	0 6 0 0 0 0 35 57 53 53 53 0 0 0 0 0		Ų:	y 6		- 40		- I
G	179		65 65 65		_	w	~	- ⊁⊖ਂ		Ü	- :: 0		on on	- g	- t t. ⊕	= 10	977	
· 🖙	===	~	c	من	4		~	<u>- 5</u> €	i	Ü.			<u> </u>	(f) 673	75	00000		rr f
9	လ		9	1.0		w	~	- 3 -		1, 3,	- 2 6			1 5 G		f co		Ę
2	œ	~	en	5 5 5 5 5 5	A.		~	- 5 =			- 5			- 5 0		- 50		ř
	co co		9 9 9 9			w	~	- g ca			- S. C			્ ⊶ ≎ ⇔				!
	5.0	_	-	٠,	منه	سا	~	→ 2 ⇔						· 2 C3		1 1 0 0 0		}
- 43	co		c.	4		e	~	- 5 0			11111		1	C C				į į
جب ج	œ	~	i co	~	**	4	~	- <u>:</u> = -		ÇY.			ġ.	: 3 cm		- 6		
, ro	((E 6	r,	~	u	~	- 0 0		10	- 2 -							140 F
	co		279	ر. ح			~	- 20	٠,	•	_ 			0 60	1 4	🙏 🖘	22	1 " 🕆
د ت	 	~	50 E	رن بن		س.	~	- 3 -		111	. ; -		James	1 80	fam.	: C		17. 1
	67		: 	<u>.</u> ~	ئ	. ພ		E						→ 2 €		- : 0		į.
	00		· ~	ري.	<u>د</u>	وسا	~	- 3 -						- 7 -		- 30		ì,
	0,	-		c,		ິພ	~	- > 0			3 6			- 5 69		1 . 6		F -
	co					. س	~	- 2 -								- 70		1
	.50	~	, m		.	. (4) . (4)	, ~ •	- 30						3; em		- 7 (-3		Ė
	00 CD	-	, m		عند ساء	اما داده	~ ~				1 1 00					- ; -		,
					5.0		22222222	11111111111111111111111111111111111111			11111			: co		, § .c.3		
2.		_					. ~			• : ::::	- :		1 1 1	ائي سند از درساف				g
	E=3	-	. (7)			· :	. ~	2 C3	1 .		- 70			end (i) ens				i
																		1

Indu	icer 2	Im	peller	Perto	rmano	e Prog	rang	PUNCHING	GRAPHIC			1 1 1	AGE OF
Frankling 8					DA	A1E	:	INSTRUCTIONS	PUNCH			CA CA	PO TECT NO FEDERALES
T Districted T							FORTRAN	STATEMENT	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				DEFIBICATION SUBJECT
	9 9 1· 11 12	13 14 15	16 17 19 19 2:	21 22 23 24 25	75 77 28 29 10	1 32 31 34 15	16 11 (4 (9 5	- f	38 47 AR 49 50		SA 67 19 50 A	V2 V3 V2 V2 V VV VV V V V V V V V V V V	}+
832			7		511	1/1	MP	BBI	7/	Bt	37/	ETZP	AFLIM
02			2		181_	5	-1	BLA	-2	RI	46	S\$L	071
DR.		_01	7/	- X	N.	FLA.	76	VIS			LAG	ESIIR	SFFS
			3	X	NTH	P					-DF	15LIP	WLABA
1													

1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 27 23 24 25 26 27 28 29 30 31 37 33 34 35 36 37 39 39 40 41 47 43 44 45 46 47 48 49 50 51 57 53 54 55 56 57 58 59 60 61 67 68 69 70 71 72 73 74 75 76 77

```
" " LEVEL 18 ( SEPT 69 ) " --
                                                              TUS7360 FORTRAN H ----
                                                                                                                           -CATE -- 71.014/12.37-25-
                 CUMPILER OPTIONS - NAME: MAIN.OPT=02.LINECNT=72.SUURCE.EBCDIC.NOLIST.NODECK.LOAD.MAP.NOEDIT.NOID.NOXREF
                             OMMON NAME MAIN.UPIEUZ.LINEUNIE/Z.SUUNCE:EBUDIC.NBEITINBEE
COMMON BEZ.Z.SM.WIMP.RBMI.BBTI.ABI.PHIZ.CMZ.SFFS.AFLIM.ETIP.
COMMON BBZ.Z.SM.WIMP.RBMI.BBTI.ABI.PHIZ.CMZ.SMG.VIS.
ICUZTH.FSLIP. SCL.PRINT.DZ.BZ.CLPL.SIG.BLKZ.RMG.VIS.
DP.DHI.PHIII.XN.FLAG.P.D.XNTH.PI.IFLAG.CO.WWR.T.MESSI.GI.UZ.RZ.
       15N 0002
       ISN 0003
                                                                               XKDF.WNET.WLABA.ILAB
                             3 DEPUT . RWH . ESHR . DELK . PSIBL . PSITH . SEPCF .
                            1 F CRMAT (8F10.0)
       15N 0004
       ISN 0005
                              REAU(5.1)XK.XZ.XFR.XR
       15N 0006
                            2 CALL INPI
       15N 0007
                              GO TO (3.4) MESSI
       15N 000H
                           3 R2=02/2.
                              DI1=011/2.
       ISN DOOR
       ISN 0010
                              CCL=CLHL /2.9
                              DELK=25.0/CCL
       ISN COLL
       ISN 0012
                              1L\Lambda B = 0
                              IF (FLAG) 60.60.61
       154 0013
       15N 0014
                          60 PHINT = 1.
       150 0015
                              GU. TO 10
       15N CO16
                          -61 PRINT = 0
       ISN 0017
                           10 CALL ILUSS
       15N 0018
                              PSITE=PSITH-PSIEL
                              PSIPS = PSIIP - 0.5 * (PHI2**2 + (CU2TH/U2)**2)
UPIPS=PSIPS*U2**2/32.174*RHU/144.
       ISN 0019
       15N 0020
       15N-0021
                              TF(fLAG) 35.35.30
       15% 0022
                           30 DPFF=-1045E-07*+025*RHU*XN**2*(R2**2-RT1**2)
                              Paperes-OPEF
       15% 0023
                              CALL CLAR
       15N 0024
       15% 0025
                              IF (PRINT) 55.55.50
       15N 0026
                          55 IF (ABS(NLABA-WWR)-0.1) 102.102.103
       ISN 0027
                         103 IF (WLAPA - WWR) 104.102.105
       15N 0028
                         104 WLAHA = WLAHA + - .1 --
                              GU TO 106
       15N 0029
       15% 0030
                         105 WLABA = WLABA - .1
                         106 ILAH = ILAH + 1
       15N 0031
                              1F(1LAB-12) 10,10,102
       154.0032
       154 0033
                         102 PRINT = 1.
       15N 0034
                              WLABA = WWR
       ISN 0035
                              G0 10 10
       15N 0036
                          50 (F(!FLAG) 5.5.6
       154 0037
                           6 DLPOF = 0
       15N 0038
                              *** = 0
                              GO TO 8
       ISN 0039
                          35 WWH = 0.
       15% 0040
                           5 CALL DERBY
       15N 0041
                            B PSIIN=PSITH+DLPDF
       15N 0042
                          CTAID=PSIIP/PSIINAWIMP/(WIMP+WWR)
19 FORMAT(5x.*SLIP COEFFICIENT, SLPCF**31X*F10*4*2X******)
       15% 0043
    -- ISN 0044
                           7 FURNAT (5X, THEORETICAL HEAD COEFFICIENT. PSITH , 19X.F10.4.2X, ****
      15N 0045
                          11 FURMAT(5X.*IMPELLER HEAD COEFFICIENT. PS1IP*.22X.F10.4.2X.*****)
       ISN COAR
                          13 FORMAT (SX. * INPUT/ HEAD COEFFICIENT. PSIIN* . 25X. F10.4.2X. *****)
      154 0047
                          21 FURNAT (BX. IMPELLER STATIC HEAD COEFFICIENT, PSIPS . 15X.F10.4.2X.
       ISN 0048
                          23 FORMAT(5X, *IMPELLER STATIC PRESSURE RISE, DPIPS*, 18X, F10, 4, 2X, *LE/
      ISN 0049
                             1501N*)
                          17 FORMAT(DX. * OPTIMIZATION PARAMETER. ETAIO*. 25%. F10.4.2X. *****)
       ISN 0050
       15N 0051
                              WRITE(6.19) SLPCF
                              WRITE(6.7) PSITH
       154 0052
       15N C053
                              WRITE(6.11) PS11P
       ISN 0054
                              WHITE (6.13) PSIIN
       ISN 0055
                              WRITE(6.21) PSIPS
       ISN 0056
                              WRITE(6,23) DPIPS
       15% 0057
                              WRITE(6,17) ETAID
       15N 005B
                              1F (FLAG) 45,45,40
       ISN 0059
                          40 CONTINUÉ
                          2/ FURMAT(/5X. **** LAUYRINTH DATA ****./)
       15N 0060
                          29 FORMAT(5X. LABYRINTH DIAMETER. D. 33X.F10.4.2X. IN.)
       ISN 0061
                          31 FORMAT(5X.*RADIAL CLEARANCE, CO*.34X.F10.4.2X.*!N*)
33 FORMAT(5X.*NUMBER OF TEETH, XNTH*.33X.F10.4.2X.*****)
       15N 0062
       ISN 0053
                          37 FORMAT(5x. *TOOTH SPACING. PI*, 37x.F10.44.2X.*!N*)
- 39 FORMAT(5x. *TOOTH WIDTH. T*. 40x.F10.44.2X.*!N*) -----
       15N U064
    - 15N 0065
```

PAUF COL 41 FORMAT(5X.*PRESSURE DROP. P*.38X.FIQ.4.2X.*LU/SDIN*)
15 FORMAT(5X.*LABYRINTH FLOW RATE, WWR*.30X.FIQ.4.2X.*LB/SEC*)
WRITE(6.27)
WRITE(6.29) O
WRITE(6.31) CO
WRITE(6.31) CO
WRITE(6.33) XNTH
WRITE(6.33) T
WRITE(6.39) T
WRITE(6.39) T
WRITE(6.15) WWR

45 CONTINUE
GO TO 2
4 STOP
END ISN 0066 ISN 0067 ISN 0068 ISN 0069 ISN 0070 ISN 0071 ISN 0073 ISN 0073 ISN 0075 ISN 0076 ISN 0076 ISN 0076 ISN 0077 2

```
05/360 FORTRAN H ........ CATE 71.014/12.37.34 .....
    LEVEL 18 ( SEPT 69 )
                COMPILER OPTIONS - NAME: MAIN.OPT=02.LINECNT=72.SOURGE.EUCDIC.NGLIST.NODECK.LOAD.MAP.NGEDIT.NDID.NGXREF
       15N 0002
                             SUBMOUTINE ILUSS
CUMMON XK(8).XZ(8).XZ(8).XR(8).XR(8)
COMMON BE2.Z.SM.WIMP.BEMI.BETI.ABI.PHI2.CM2.SQL.SFFS.AFLIM.EIIP..
ICU2TH.FSLIP. SCL.PRINT.D2.E2.CLBL.SIG .BLK2.RHG.VIS. DTI.
2 DR.DH1.PHIIT.XN.FLAG.P.O.XNTH.PI.IFLAG.CC.TWR.II.MESSI.UI.U2.R2.
3 DL.DDF.RWR.ESHR.DELK.PSIBL.PSITH.SLPCF. XKDF.WNET.WLAHA.ILAB.—
EGUJ.VALENCE (PSITH.PSIT).(PHI2.PHI).(U2.U)
       15N 0003 ----
       15% 0004
      ISN 0005
                              THNSK=.5
      ISN 0006
                              $16 = 1.2
BHM1R=BEM1/57.296
BBT1R=BBT1/57.296
       ISN 0007
      ISN 0008
       ISN 0009
                              HH2R=882/57.296
       15N 0010
                              A1 = 0.7853975 * (DT1**2 - DH1**2)
DM1 = SORT(0.5 * (DH1**2 + DT1**2))
       ISN 0011
      15N 0012
                              WIMP = WNET + WLABA
       ISN 0013
                              01=W1MP#448.8/RHD
       ISN 0014
                              U2=02*XN/229.
       ISN 0015
                              A2 = 3.1417 * 02 * 82 * (1.-8LK2)-
       ISN 0016
                              CF2 = .321 * GI/A2
       ISN 0017
                              PHIS = CM2/U2
      ISN 0018
                              CUZE=U2-CM2/SIN(BB2R)*COS(BB2R)
      ISN 0019
                          -- IF(BH2-90.) 20.25.25

20 PSISL = F5LIP * (1. + 882/60.)

PSL=PSISL*R2*42/Z/SM
       15N 0020
       ISN 0021
       15N 0022
                              SLPCF=1./(1.+PSL)
       15N 0023 '
                          --- GO TO 26
25 SEPCF=1.-1.98/Z
       15N 0024
       ISN 0025
                           26 CU2TH#SLPCF *CU2E
       ISN 0026
                              CM1 = 0.321 * 01/A1
       15:1 0027
                              UT1 = XN + UT1/229. ----
    -- ISN 0028
                               WII = SORT(CM1*42 + UT1*42)
       15N 0029
                               WU21H=U2*(1.-SEPCF*(1.-PHI2*COS(BD2R)/SIN(BB2R)))
       15N 0030
                               W2 TH=SCRT(CM2**2+WU2TH**2)
       15.54 00 31
    -- 154 0032
                              RW = W2[H/W[]
                              UIM = XN + DM1/229.
       ISN 0033
                               1F(AFL1M) 30.35.40
       15% 0034
                           30 AFIMR = ABS(AFLIM)/57.296
       159 0035
                              ω___1šν ορ<u>ιο</u>
       ISN 0037
                               GO TO 42
       ISN 0038
       ISN 0039
                           35 CULW = 0
                              BEMIR = ATAN(CMI/UIM) ---
       15N 0040
       15% 0041
                               GO TO 42
                           40 AFINR = AFLIM/57.296
       ISN 0042
                              CUIM = CM1 + SIN(AFIMR)/COS(AFIMR)
       ISN 0043
                              HEMIR = ATAN(CMI/(UIM - CUIM))-
       15N 0044
                           42 PHIPT = CMI/UIM
       ISN 0045
                              PSINC=0.13*(PHIM1*(COS(BFMIR)/SIN(BFMIR)-COS(BBMIR)/SIN(BBMIR)))**
       ISN 0046
                             12
                              WUM1 = UIM - CUIM
   --- ISN 0047
                               WM1 = SCRT(CM1**2 + WUM1**2)
       15N 0048
                               WMR = 0.5 * (WM1 + W2TH)
       ISN 0049
                              PASW = D2*SIN(BB2R) * (1-BLK2)/Z * 3.1417

DHYD = 2.*-82 * PASW/(PASW + B2)

REIMP=DHYD *RHU*WMR /(96.522*VIS)

IF(REIMP-1.8+05) 37.37.38

EDIMP=0.003240.2017DEIMD*0.277
       155 0050
     -- ISN 0051
       15N 0052
       153 0053
                           37 FRIMP=0.0032+0.221/REIMP**0.237
       15N 0054
                               GU TO 39
       155 0055
                           38 FRING = 1./(0.86858*ALOG(OHYD /(2.*SFFS ))+1.74)**2
39 HLF1P=WMR **2/64.33*(FRIMP*CLBL /DHYD)
       ISN 0056
       155 0057
                               PSF1P=32.174*HLF1P/U2**2.
       ISN 0058
                               PSTIP=THNSK*(PH12*BLK2)**2"
       15N 0059
                               DIFP = 1.- W2TH/WM1 +(WU2TH-WUM1 )/(2. * SCL * WM1.)
        15% 0060
                               PSD = 0.08 * DIFP**3
        15% 0001
                               PSIBL = PSINC + PSFIP + PSD + PSTIP
        15% 00%2
                               PSITH = CU2TH/U2 - U1M*CU1M/U2**2---
        15% 0063
                               HTH=PSITH+U2++2/32+174
        154 0064
        155 0065
                               IF (FLAG) 410.410.440
```

15		PAGE 002	
SV 0065	N 0066 410 IF(SCL) 430.446	.450	•
15	N 0067 430 SCL=0.010201+0	0008095*D2+0.00011078*D2**2	
SN 0071 420 FORMATI(75X,*IMPELLEN IS SHROUDED.*/) SN 0073 DI PSCL=0. SN 0073 DI LABO. SL 0073 DI LABO. SL 0074 SCL 00. SN 0077 450 CONTINUE. SN 0077 450 CONTINUE. SN 0078 DILABOLOZ. SN 0079 DILABOLOZ. SN 0070 DIL	N 0059 440 IF(PRINT) 101.1	01.102	
SN 0072 10 PSCL=0. SN 0073 SCL=0. SSL=0. SN 0075 SCL=0. SN 0076 SO 00 0 0 SN 0077 SO 00 0 0 SN 0079 SD 00 0 0 SN 0079 SD 00 0 0 0 SN 0079 SD 00 0 0 0 0 SN 0079 SD 00 0 0 0 0 SN 0079 SD 00 0 0 0 0 SN 0080 0 0 0 0 0 SN 0081 A1 5705-8528 ((viscupt*cos(a)*DELK*(PHI**)1)** SN 0081 A1 5705-8528 ((viscupt*cos(a)*DELK*(PHI**)1)** SN 0082 F 1 0 0 SN 0083 F 1 0 0 SN 0084 F 1 0 0 SN 0085 SD 0085 0 0 0 SN 0085 SD 0085 0 0 SN 0085 0 0 SN 0085 0 0 0		ELLER IS SHROUDED**/)	
15A 0774 DELPSO	N 0072101PSCL=0		
SN 0076	N 0074 DELR=0.		
15N 0076	N 0076 GO TO 470		
ISN 0079 UD-=112702 US112702 US112702 US112703 US1			
ISN 0081 CLPT=CLBL /12*,	N 0079 BDR#82702		
151 0013	N 0081 CLPT=CLHL /12.		
15N 0085	N 0083 A=1.5708-862R		
ISN 0086		VI*CLPI*COS{A}*DELK/(PHI*U}}	
15N 0088	N 0086 TF(Y-2.)1.2.2		
ISN 0090 OFLE=DELR+G08+.3+(1+\cos(A)) ***2/G+F1)**1.5*(8DR*COS(A))	N-0088	×6.17=6.2	
15N 0092	N 0090 3 G=PH[*PS[T/(S]0	*COS(A))	
ISN 0093	N 0091: DELE=DELR*G***	*(1 - + (CDS(A))**2/G*FI)**1.*5/(8DR*CDS(A))	
15N 0096 55 FORMAT(5x,* IMPELLER LOSSES*.//) 15N 0096 57 FORMAT(7,5x,****-0UTPUT ******.//) 15N 0097 12 FORMAT(7,5x,****-0UTPUT ******.//) 15N 0098 14 FORMAT(7,5x,***-10.3,24x,*7HPSINC =.3x,F10.4* 124x,77HO2 = .3x,F10.3,24x,*7HPSINC =.3x,F10.4* 15N 0099 16 FORMAT(5x,**THOELE =.3x,F10.3,24x,**THPSINC =.3x,F10.4* 124x,77HOELK =.3x,F10.3,24x,**THPSINC =.3x,F10.4* 124x,77HC2 = .3x,F10.3, 15N 0100 18 FORMAT(5x,**THOELE =.3x,F10.4,**INFORMATION =.3x,F10.4* 124x,77HP12 = .3x,F10.3,24x,**THPSINC =.3x,F10.4* 15N 0101 28 FORMAT(5x,**THWETH =.3x,F10.3,24x,**THPSINC =.3x,F10.4* 15N 0102 22 FORMAT(5x,**THWETH =.3x,F10.3,24x,**THPSINC =.3x,F10.4* 15N 0103 22 FORMAT(5x,**THWETH =.3x,F10.3,24x,**THPSINC =.3x,F10.3) 15N 0104 27 FORMAT(5x,**THWITH =.3x,F10.3,68x,**THUIM =.3x,F10.3) 15N 0105 29 FORMAT(5x,**THWITH =.3x,F10.3,68x,**THUIM =.3x,F10.3) 15N 0106 17 FORMAT(5x,**THWITH =.3x,F10.3,68x,**THUIM =.3x,F10.3) 15N 0107 10 WRITE(6.55) 15N 0110 WRITE(6.55) 15N 0110 WRITE(6.12) SCL,PSINC.U2 15N 0110 WRITE(6.12) SCL,PSINC.U2 15N 0111 WRITE(6.12) WZTH,PSCL,FRIMP 15N 0115 WRITE(6.22) WZTH,PSCL,FRIMP 15N 0116 WRITE(6.22) WZTH,PSCL,FRIMP 15N 0117 WRITE(6.22) WZTH,PSCL,FRIMP 15N 0116 WRITE(6.22) WZTH,PSCL,FRIMP 15N 0117 WRITE(6.22) CMIH*CUIM WRITE(6.27) WIMP,CUIM 15N 0117 WRITE(6.27) WIMP,CUIM 15N 0117 WRITE(6.27) WIMP,CUIM 15N 0117 WRITE(6.27) WIMP,CUIM 15N 0118 WRITE(6.	N 0093 PSIBL=PSIBL+PSC		
1SN 0097 12 FGMMAT(7/5X,7HSCL =,3X,F10.3) 24X,7HPSINC =,3X,F10.4, 124X,7HU2 =,3X,F10.3) 14 FCMMAT(5X,7HDELE =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 124X,7HU2 =,3X,F10.3) 124X,7HDELE =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 124X,7HCM2 =,3X,F10.3) 124X,7HCM2 =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 125N 0100 18 FGMMAT(5X,7HDELR =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 124X,7HPH12 =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 125N 0101 28 FGMMAT(5X,7HW2 =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 124X,7HRIMP =,3X,F10.4, 15N 0102 22 FGMMAT(5X,7HWM =,3X,F10.3,24X,7HPSINC =,3X,F10.4, 124X,7HGIPP =,3X,F10.3, 1SN 0103 24 FGMMAT(5X,7HWHM =,3X,F10.3,68X,7HUM =,3X,F10.3) 1SN 0104 27 FGMMAT(5X,7HWHM =,3X,F10.3,68X,7HUM =,3X,F10.3) 1SN 0105 29 FGMMAT(5X,7HCM1 =,3X,F10.3) 1SN 0105 29 FGMMAT(5X,7HCM1 =,3X,F10.3) 1SN 0106 47 FGMMAT(5X,7HCM1 =,3X,F10.3) 1SN 0107 110 WRITE(6.55) WRITE(6.14) DELE,PSFINC,U2 1SN 0107 WRITE(6.14) DELE,PSFINC,U2 1SN 0111 WRITE(6.16) DELE,PSFINC,U2 1SN 0112 WRITE(6.16) DELE,PSFINC,U2 1SN 0113 WRITE(6.16) DELE,PSFINC,U2 1SN 0114 WRITE(6.20) WZTH,PSCL,FRIMP 1SN 0115 WRITE(6.22) WZTH,PSCL,FRIMP 1SN 0116 WRITE(6.22) WZTH,PSCL,FRIMP 1SN 0117 WRITE(6.22) CMI MP,CUIM WRITE(6.27) WRIPCCUIM WRITE(6.27) WRIPCCUIM WRITE(6.27) CMIPCCUIM WRITE(6.27) WRIPCCUIM WRITE(6.27) CMIPCCUIM	M DOGS SS FORMATISK. IMPR	LLER LOSSES*,//)	
124x,7HU2	N-0096	*****OUTPUT ********/*//- = .3X.F10.3*.24X.7HPSINC =.3X.F10.4*	
124x.7HCUZIH = 33x,F10.3 15N 0099	124X.7HU2 = .:	X,F10.3)	
124x,7HCM2 = .3x,F10.3)	124X.7HCU2TH = .:	X,F10.3)	
124x,7HPHI2 = 3X,FI0.3)	N 0099 16 FURMAT(5X,7HDE) 124X,7HCM2 =.	<pre></pre>	
ISN 0101 28 FORMAT (5x.7HW2TH =.3x.F10.3.24x.7HPSCL =.3X.F10.4. 124x.7HRRIMP =.3x.F10.3) 22 FORMAT (5x.7HRW =.3x.F10.3.24x.7HPSIBL =.3x.F10.4. 124x.7HDIFP =.3x.F10.3] ISN 0103 24 FORMAT (5x.7HWIM =.3x.F10.3.68x.7HU1M =.3x.F10.3) ISN 0104 27 FORMAT (5x.7HWIMP =.3x.F10.3.68x.7HCU1M =.3x.F10.3) ISN 0105 29 FORMAT (5x.7HWIMP =.3x.F10.3.68x.7HCU1M =.3x.F10.3) ISN 0106 1	N 0100 18 FORMAT (SX. 7HDEL	R = 3X.F10.3.24X.7HPSTIP = ,3X.F10.4.	
ISN 0102 22 FURMAI (5X,7HRW = .3X,F10.3,24X,7HPSIBL = .3X,F10.4. ISN 0103 24 FURMAI (5X,7HHTH = .3X,F10.3,68X,7HUIM = .3X,F10.3) ISN 0104 27 FURMAI (5X,7HWIMP = .3X,F10.3,68X,7HUIM = .3X,F10.3) ISN 0105 29 FURMAI (93X,7HUIM = .3X,F10.3) ISN 0106 1f(PRIN1) 108.108.110 ISN 0106 WRITE (6.55) ISN 0108 WRITE (6.57) ISN 0109 WRITE (6.12) SCL.PSINC.U2 ISN 0110 WRITE (6.14) DELE.PSFIP.CU2TH ISN 0111 WRITE (6.16) DELK.PSD.CM2 ISN 0112 WRITE (6.16) DELK.PSTIP.PH12 ISN 0113 WRITE (6.28) W2TH.PSCL.FRIMP ISN 0114 WRITE (6.28) W2TH.PSCL.FRIMP ISN 0115 WRITE (6.24) HIH.UIM ISN 0116 WRITE (6.24) HIH.UIM ISN 0116 WRITE (6.27) WIMP.CUIM ISN 0117 WRITE (6.29) CM1	N 0101 28 FORMAT(5X.7HW2	H =,3x,F10.3,24x,7HPSCL =,3X,F10.4.	
124x,7hD1FP = 3x,F10.3 ISN 0103 24 FURMAI(5x,7hHTH = 3x,F10.3,68x,7hU1M = 3x,F10.3) ISN 0104 27 FORMAI(5x,7hWIMP = 3x,F10.3,68x,7hCU1M = 3x,F10.3) ISN 0105 29 FORMAI(93x,7hCM1 = 3x,F10.3) ISN 0106 1f (PRINI) 108:108:110 ISN 0107 110 WRIFE(6.55) ISN 0108 WRIFE(6.55) ISN 0109 WRIFE(6.12) SCL,PSINC,U2 ISN 0110 WRIFE(6.12) SCL,PSINC,U2 ISN 0111 WRIFE(6.16) DELK,PSD,CM2 ISN 0112 WRIFE(6.16) DELK,PSD,CM2 ISN 0113 WRIFE(6.28) WZTH,PSCL,FRIMP ISN 0114 WRIFE(6.28) WZTH,PSCL,FRIMP ISN 0115 WRIFE(6.24) HTH,UIM ISN 0116 WRIFE(6.27) WIMP,CU1M ISN 0116 WRIFE(6.27) WIMP,CU1M		X+F10-4) = 3X-F10-3,24X-7HPS18L = 3X-F10-4*	
ISN 0104 27 FORMAT(SX.7HWIMP = 3X.FT10.3) ISN 0105 29 FORMAT(SY.7HWIMP = 3X.FT10.3) ISN 0106 1F(PRIN1) 108.108.110 ISN 0107 110 WRITE(6.55) ISN 0108 WRITE(6.57) ISN 0109 WRITE(6.12) SCL.PSINC.U2 ISN 0110 WRITE(6.14) DELE.PSF1P.CU2TH ISN 0111 WRITE(6.16) DELK.PSD.CM2 ISN 0111 WRITE(6.16) DELK.PSD.FM2 ISN 0112 WRITE(6.16) DELK.PSTIP.PH12 ISN 0113 WRITE(6.28) WZTH.PSCL.FRIMP ISN 0114 WRITE(6.22) WZTH.PSCL.FRIMP ISN 0115 WRITE(6.24) HIH.UIM ISN 0116 WRITE(6.27) WIMP.CU1M ISN 0117 WRITE(6.29) CM1	124X.7HDIFP=.	=.3x.F10.3.68x.7HUIM =.3X.F10.3)	
ISN 0106	N 0104 27 FORMAT(5X.7HWI)	ρ = 3χ. F10-3, 66χ. 7HCULM = ,3χ. F10-3)	
ISN 0108 WRITE(6.57) ISN 0109 WRITE(6.12) SCL.PSINC.U2	N 0106 IF(PRINI) 108.	08,110	
SN 0110	N 0108 WKITE(6.57)		
ISN 0111	N 0110	E.PSFIP.CU2TH	
ISN 0113 WRITE(6,28) WZTH-PSCL,FRIMP	N 0111 WRITE(6.16) DEI	K,PSD,CM2	
ISN 0115 WRITE(6.24) HTH.UIM ISN 0116 WRITE(6.27) WIMP.CUIM ISN 0117 WRITE(6.29) CM1	N 0113 WRITE(6,28) W2	H.PSCL.FRIMP	
ISN 0116 WRITE(6,27) WIMP, CUIM ISN 0117 WRITE(6,29) CM1 ISN 0118 108 HETURN	N 0115 WRITE(6,24) HT	•UIM	
	N 0116 WRITE(6,27) WI	P.CUIM	
15N 0119	N-0118		
	W 0113		
	•		

```
OS/360-FORTRAN-H--
... LEVEL 18 ( SEPT 69 ) ...
                         COMPILER OPTIONS - NAME: MAIN.OPT=02.LINECNT=72.SOURCE.EBCDIC.NCLIST.NCDECK.LGAD.MAP.NCEDIT.NUID.NOXREF
                                                  SURROUTINE DERBY
        ISN 0002
                                                                       XK(8).XZ(8).XFR(8).XR(8)
                                                  COMMON -
                                               CUMMUN XK.07.XZ.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07.XF.07
        15N 0004
                                                3 DLPDF . KWK . ESHR . DELK . PSIBL . PSITH . SLPCF . XKDF . WNET . WLAHA . ILAB
                                                  RE2=U2*R2*RHO/(386.*V15)
        154 0005
                                           1F (FLAG) 10.20.20
10 RBV2=R2+DR
        15N 0006
         ISN 0007
                                                  RUV1=R2/2.
       15N 0009
                                                  SEV=SCL/.17+SCL
        1 SN 0009
                                                  CMIP= . 1048*XN
        15N 0010
        ISN 0011
                                                  TEMP=SBV/.8/SCL-1.
                                                  XBV=TEMP*(40./(1.+5.*SBV/RBV2)*RE2-**.2/.56*(SBV/RBV2))**.5
        15N 0012
                                                  RUMBV=XUV/(1.+XUV)
        15N 0013
                                                  DMFL = UM [ P + ROKBV.
        ISN 0014
                                                  TOBV=.1562E-07*RHO*40.*((RBV2)**4-(RBV1)**4)*SBV*(OMIP-OMFL)**2*(T
        15N 0015
                                                 IEMD1**2
                                                  PERV=OMIP*ICRV/550.
        ISN 0016
                                                  PERS=D.
         ISN 0017
                                                  PFFS=0.
         15N 0018
                                                 XKDF=0.
        158 0019
                                                  GO TO 35
        15N 0020
                                           20 REX=R2+DR
        15% 0021
                                                  RUS=.3*R2
        15% 0022
                                                  IF (XKUF) 25,25,23---
        15N 0023
                                           25 IF (RE2-10. * +6) 21.22.22
        15N 0024
                                           ISN 0025
        15N 0026
                                                  GO TO 23
                                           22 XKDF =31.5E-08/RE2 **0.164
        ISN 0027
        15N 0028
                                           23 CONTINUE
                                                  XPDF = 4 . 61E+09 * XKDF * RHU * XN * * 3
       1511 0029
                                                  PFBS=XPDF+(REX++4+(2.*REX+5.*ETIP)-2.*(RUS*+5-REX+*5+R2**5))--
       154 0030
        15N 0031
                                                  DEBV=0.
                                                  11 (FLAG) 31.31.32
        15N 0032
                                           31 PFF5=0.
        15V 0033
        15N 0034
                                                 60 10 35
                                           32 RWR = 0.5 + 0
        15N 0035
                                                  RT1=DT1/2.
        15N 0036
                                                  PEFS1=XPDF*(RWR**4*(2.*RWR+5.*ESHR)-2.*RT1**5)
        15 ( 0037
                                                  PFFS2=XPDF+(R2*+4*(2.*R2+5.*ET(P)-2.*RWR+*5)-
        15N 0038
                                                  PFFS=PFFS1+PFFS2
        ISN 0039
                                            35 PETCT=PEBV+PEES+PEBS
        15N 0040
                                                  DLPDF = 17680 . *PFTOT/(U2 **2 *WIMP)
        ISN 0041
                                           12 FORMAT(5X.*HEYNOLDS NO.* IMPELLER, RE2*.11X,E10.4.2X.*****)
13 FORMAT(5X.*DISK FRICTION COLFF.* XKDF*.12X.E10.4.2X.*****)
14 FURMAT(5X.*PDWE7. HACKVAKES. PFBV*.16X.F10.2.2X.*HP*)
        15N 0042
        15N 0043
        15N 0044
                                            15 FORMAT(5x. POWER. BACK FACE, PERS . 16x. F10. 3.2x. HP.)
                                           16 FORMAT(5x.*POWER. BACK FACE. PPHS*.10x.F10.5.22x.*HP*)
16 FORMAT(5x.*POWER. FRONT FACE. PFFS*.15x.F10.3.22x.*HP*)
17 FORMAT(5x.*POWER., TOTAL. PFTOT*.19x.F10.3.22*.*HP*)
18 FORMAT(5x.*LUSS COEFF.. DLPDF*.20x.F10.4.2x.*****//)
        154 6045
        150 0040
        ISN 0047
        15N 0048
        154 0049
                                                  WRITE (6.12) RE2
                                                   WHILL(6.13) XKDF
      - 15N UUSO
                                                   WRITE(6.14) PEBV
        15N 0051
                                                   WRITE(6.15) PEUS
        15N 0052
                                                   WRITE (6.16) PEFS
         154 0053
                                                   WRITE(6.17) PETOT
        ISN 0054
                                                   WRITE (6.18) DLPOF
        ISN 0055
        154 0056
                                                  RETURN
         ISN
                 0057
                                                  FND
```

```
****LEVEL* 18 ( SEPT 69 ) *** ***
                                                ---- US/360- FURTRAN H
                                                                                                                CATE = 71.014/12.37.58
                 COMPILER OPTIONS - NAME: MAIN-OPT-02-LINEONT-72-SOURCE-EBCDIC-NCLIST-NCDECK-LUAD-MAP-NCEDIT-NDID-NOXREF
                             SUBROUTINE INPI
COMMON XK(8).XZ(8).XFR(8).XR(8)
         15N 0002
         ISN 0003
         ISN 0004
                             COMMON BB2.2.SM.WIMP.BBM1.BBT1.AB1.PHIZ.CM2.SDL.SFFS.AFLIM.ETIP.
                            1CU2[H.FSL[P. SCL.PRINT.02.82.CLBL .SIG.8LK2.RHO.VIS, DII.
2 DR.PHI.PHIIF.XN.FLAG.P.D.XNTH.PI.IFLAG.CO.WWR.F.MESSI.0I.U2.R2.
                            3 DEPOF.RWR.ESHR.DELK.PSIEL.PSITH.SEPCF. .....XKDF.WNET.WEABA.ILAB
        15N 0005
                             ME 551=1
                           1 FORMAT(8F10.0)
        ISN 0006
                           2 FORMAT(4F10.0.E10.4.110.F10.0.E10.4)
         ISN 0007
                           3 FORMAT (4X,8E14.4) ....
        ISN 000H
                           ISN 0009
        ISN 0010
         ISN OUII
         ISN 0012
        15N 0013
                          51 MESS1=2
         ISN 0014
                             GC TO 100
         15N 0015
                          50 REAU(5.1) D2.82.CLBL.SCL.BLK2.RHQ.SOL.DT1
        -15N 0016
                             READ(5.2) DR. OHI. XN. FLAG. VIS. IFLAG. ESHR . SFFS
         ISN 0017
                             READ(5.5) D.CO.XNTH.PI.T.XKDF.FSLIP.WLABA
         15N 0018
                          10 FORMAT( 11 . //5x . 'INPUT 1//)
        ISN 0019
                             WRITE(6.10)
        ISN 0020-
                           6 FURMAT(11X.*BB2*.11X.*Z*.13X.*SM*.12X.*WNET*.10X.*BBM1*.10X.*BBT1*--
                            1.11X. 'ETIP' . 8X. 'AFLIM' }
                           7 FORMAT (/11x . 102 . 14x . 182 . 11x . CLEL . 10x . SCL . 10x . BLK2 . 10x . RHO
        ISN 0021
                            1 * . 10 x . 'SGL ' . 10 X . 'DT1 ')
      -- ISN 0022-
                          9 FORMAT(/11X, OR*, 12X, OH1*, 12X, XN*, 10X, FLAG*, 10X, VIS*, 11X, FLAG*
                            1G'. 9X. 'ESHR'. 10X. 'SFFS')
        ISN 0023
                           8 FORMAT(/11X.'D'.13X.'CO',12X.'XNTH',10X.'PI'.11X.'T'.12X.'XKDF'.11
1X.'FSLIP'.9X.'WLABA')
                            FORMAT (4X,8E14.4///)
       - 15N 0024-
                             WRITE (6.6)
        ISN 0025
        ISN 0026
                             WRITE(6.3)UB2.Z.SM.WNET.BBM1.BUT1.ETIP.AFLIM
        ISN 0027
                             WRITE(6.7)
        6500 NZ1
                             WRITE(6.3) D2.82.CLBL.SCL.BLK2.RHO.SDL.DT1:-----
                             WRITE (6.9)
        ISN 0029
        ISN 0030
                             WRITE(6.4) DR. DHI. XN. FLAG. VIS. IFLAG. ESHR. . SFFS
                             WH(IF(6.8)
        15N 0031
)6
        ISN 0032
                             WRITE(6.11)-D.CO.XNTH.PI.T.XKDF.FSLIP.WLABA-
        ISN 0033
                         100 RETURN
        15N 0034
                             END
```

	OS/360 FORTRAN H	CATE 71.014/12.37.53
" LEVEL-18 (SEPT 69)		
ISN 0002	TIONS - NAMER MAIN.OPT=02.LINECNT=72.SOURCE.EBCDIC.NCLIST.NCDECK.LOAD	J. MAP. NEEDIT. NOTO. NEXREP
ISN 0004	COMMON — XK(8).XZ(8).XFR(8).XR(8) COMMON BB2.Z.SM.WIMP.BBM1.BB11.AB1.PH12.CM2.SDL.SFFS.AFL1M.ETIP. CU2TH.FSLIP. SCL.PRINT.D2.B2.CLBL .SIG.BLK2.RHO.VIS. DT1. DR.DH1.PH11T.XN.FLAG.P.D.XNTH.P1.IFLG.CO.W.T.MLSSI.Q1.U2.R2.	
	DLPOF.RWR.ESHR.DELK.PSIHL.PSITH.SLPCF	
15N 0006	COEC=+67.	
ISN 0008	TAZZ * SKRUTZZ * 1741 PF 144 * FR = SOK F (FA) S = J * 1416 * CO * (D + CO) / 144 *	
15N 0010	CF=(XNTH-1.)*(18.52/((PI-T)/CO+7.23))+1.	
- 154 0012	DO 40 !=1.3 COE=COEC_SURT(CF)	
ISN 0014	#=COL*5\FH RE=CO#\/(6.*S\VI*RHU)	•
ISN 0015	ZLAH=1/CO 1F(RE-60.1200.200.300	
ISN 0017 200	KZ=ZLABZRE CALL INTALXZ.XK.RZ.EKI	
15N 0019 15N 0020	COEC=1./SQRT(64./RE+48.*ZLAB/RE+FK)	
15N 0021 300	RE = ALUG(RE)	
124 0053 124 0055	CALL (UIA(XR.XFR.RE.FFR) FFR=EXP(FFR) RE=FXP(RE)	
ISN 0025	COEG=+62*RE**•0085	
ISN 0027 310	IF(ZLAB-1.15) 310,310,320	ì
- ISN 0028	5U 10 330	
150 0030 330	1E URE-6000 - 1340 - 340 - 350	
	COEC=1./SOR((1/COEO**2-F*(2*SORT(1/COEO**2-64./NE)-2.)+2.*FFR*ZLAB	
15N 0033 350	GC TO 40 CUEC=1./SORT(1./COEO**2-(2./COEO-2.)*F+2.*FFR*ZLAB)	
154 0034 40 - 154 0035	CONTINUE RETURN	
ISN 0036	<u>IND</u>	
*		
•		
The second secon	- The Control of the	Author between the common production and the common of the company of the common of th
		•
		A - Strand Copies, while Strange
		•
The second of th		
		.mm.

```
"LEVEL" 19 ( SEPT 69 ) - ----
                                                    05/360 "FORTRAN H
                COMPILER OPTIONS - NAME - MAIN.OPT=02.LINECNT=72.SOURCE.EBCDIC.NOLIST.NODECK.LOAD.MAP.NCEDIT.NOID.NOXREF
        15N 0002
                           SUBROUTINE INTA(X.Y.XI.YC)
        154 0003
                          UIMENSION X(9).Y(9).XC(4).YC(4)
                          EGUIVALENCE (XC(1).X1).(XC(2).X2).(XC(3).X2).(XC(4).X4).(YC(1).Y1)61205006
1.(YC(2).Y2).(YC(3).Y3).(YC(4).Y4)
        ISN 0004
                                                                                            61205007
        15N 0005
                          NA=L
        ISN 0006
                          --J=2
                          B=XI
IF(X(J))26.22.26
GD ID(30.40).NA
        15N 0007
        15N G068
                      21
        ISN 0009
                      26
                           1F(Y(J))26.23.26
        15N 0010
                      22-
        ISN 0011
                           IF (J-2)24.24.25
        ISN 0012
                           YE = 0.0
        ISN 0013
                           GO TO 50
                      25-
        15N 0014
                         -- Nu=1
        15N 0015
                           J=J-1
        ISN 0016
                          X1=X(J)
        15N 0017
                           X2=X(J-1)
        15N 0018
                          X3=X(J-2)
        15N 0019
                          Y1=Y(J)
        15N CC20
                          Y2=Y(J-1)
        15N 0021
                          (S-L)Y=EY
        ISN 0022
                          -GU 10(32,42) NB-
        LSN 0023
                          IF(X(J)-8)29.37.37
        ISN 0024
                      37
                          1F(J-2)31.31.28
        ISN 0025
                      28
                          NA=2
        15% 0026
                     29
                          .J=J+1
                          GG TO 21
DG 60 J=1.3
XC(J)=X(J)
        ISN 0027
        ISN 0028
                      31
        ISN 0029
                          (L)Y=(L)OY
        ISN 0030
                      60
        ISN 0031
                      32
                          D=x2-x1
        ISN 0032
                          A1=3-X1
        ISN 0033
                          A2=0-X2
                           15N 0034
        ISN 0035
                          GU TO 50
        15N 0036
                          N8 = 2
        ISN 0037
                          GO TO 27
175
        15N 0039
                          -X4=X(J-3)
        15N 0039
                          Y4=Y(J-3)
        ISN 0040
                          D=X3-X2
        15% 0041
                          A1=3-X2
        150 0042
                          A2=8-X3 ----
        15N 0043
                          XM12=(Y2-Y1)/(X2-X1)
                          ISN 0044
        ISN 0045
        ISN 0046
                         1Y2/0+A1*Y3/D
        ISN 0047
                          YC=YE
                     50
        15N 0048
                          RLTURN
     -- ISN 0049
                          END
```

				141	0000 - L			·,,	CHILL DIVESTER	
•						Ì			ATAG HTPLEFYBAL	
	* ***									
			N.		##Z8* 2916*99#		Sat	ELEK† ELVIO EZZONE BIZE† DB	CITATION PARALE	
					£621:•		24129	AD COEFFICIENT.	LER STATE SEL	Beir I
•					\$113.				T MEAN COEFFICE	
								ELCIENT, PSTIP	<u>34300 0038 837</u> 50 0230 0601 43	
	•				8497.				* inglotages	
					······································	*** 993	:o•		COEFF. LLPOF	SSOT
						वा। ४५.			O LOLVE NELOL	121.05
				·		ی∠ن ≀ان			(1) FRONT FACE.	
						265 Hb 300 Hb			(* BYCK EVCE) E (* BYCKAVIBE) E	
							-0955.		FAICTION COLFE	
						*** LU-			าวสาม 🕶งา รถาด	
	108.47	CW1 _=							**************************************	. 7.0
	600 *	C(11 w + =								तः 18 । 16
	950 * 1195 1140 *	niw = Dleb =			*0275	= "7815	5d	T .	20.4	*Sg
	.0102	= GNINA =			0600	= - 70;		G.	28*Z09 ==	11174
	cap1.	= 71Ha			£000.	= 911,		11.	10. =	חברון
		=			2010. 0000.	اد = اد =				<u>סיירא</u> מיורב
	650°978 874°421	US =			\$020 .	= 3N1S				ำเวร
	360 0311									
				-					***** 10/1100 *	****
										
			•					:		
									รวรรดา ชสา	ІЗни І
•								G.	TEB IR SHUGADE	13eWI
and the second s										
	10+8025.	0u+u0S9*	40-002Z*	T11=0	0561*	00+0881.	10+0005	*20-0009*	10+0017.	
	ARAJW	FGLIP	KKDE KKDE		1	Id	НТИХ	00	C	
	*25uu-0# ZEE2	* e2000+00 E2HB	0 IETVe	50 - 0	0006* S1A	*10000+01 ECA6	50+69402 XII	*5380+01	. * aaoa DK	
	10+0009*	705 705	*#340+01 BHO .		FLKS 1770	0000° 738	CLiii.	*2750+00 *2750+00	SO - STOI.	
	VEETW:	*2200+00	1789 10+0028•		าเรา. เพยล	T-JUNA.	71530+05 Zw	*	289 *\$000+05	
-			4							natii

HUNGER OF TEETH, XNTH TOOTH SPACING, PI TOOTH WIDTH, T PRESSURE DROP, P EARTRINGH FLOW BATE, WWR 3.9000 *** .1830 IN .0195 IN 448.4932 LB/SOIN 2.7195 LB/SEC

COMPUTER PROGRAM

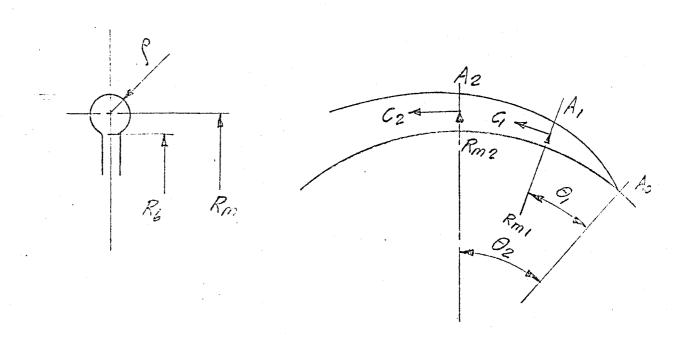
CIRCULAR CROSS SECTION VOLUTE DESIGN

I. INTRODUCTION

This program presents an incremental method for the design of a classical pump volute with circular cross-sections which are tangent to the volute base circle. Volute area distributions as well as velocity and pressure distributions are calculated and printed out.

This program was primarily devised to determine the percentage increase in cross-sectional area required for the compensation of friction losses in the NERVA turbopump volute which is discussed in Reference 1.

II. BASIC EQUATIONS



Reference 1 - Aerojet Nuclear Systems Company Engineering Operations Report
N8300R:71-076, NERVA Turbopump Design Report, Volume 1, 24
September 1971

The flow rate V in the volute is assumed to be proportional to the wrap angle θ (no back flow, zero cut water clearance flow).

The volute cross sectional area A_2 at the wrap angle θ_2 can then be calculated from the total flow at the volute throat V_{th} .

$$A_2 = \frac{\theta_2}{2\Pi} \quad \frac{V_{th}}{C_2} = \Pi \rho_2^2 \tag{1}$$

Assuming constant moment of momentum:

$$R_{m1} C_1 = R_{m2} C_2 = K$$

where:

$$R_{m2} = R_6 + \rho_2$$

Thus:

$$c_2 = \frac{K}{R_{m2}} = \frac{K}{R_6 + \rho_2}$$
 (2)

Substituting C₂ in (1)

$$A_2 = \frac{\theta_2 V_{\text{th}}}{2\pi} \qquad \frac{R_6 + \rho_2}{K} = \pi \rho^2$$

Solving for ρ the quadratic equation can be written as follows:

$$\rho^2 - \frac{\theta_2 V_{\text{th}}}{2 \Pi^2 K} \rho - \frac{\theta_2 V_{\text{th}}}{2 \Pi^2 K} R_6 = 0$$

Let

$$\frac{\theta_2 V_{th}}{2 I I^2 K} = Y$$

then:

$$\rho^2 - Y\rho - YR_6 = 0$$

and

$$\rho = \frac{Y + \sqrt{Y^2 + 4 Y R_6}}{2}$$

Friction losses are calculated for the mean cross section of a volute increment:

$$A_{m} = \frac{A_{1} + A_{2}}{2}$$

$$\rho_{\rm m} = \left(\frac{A_{\rm m}}{\Pi}\right)^{0.5}$$

Length of volute increment:

$$L_{\rm m} = \Delta \theta R_{\rm m}$$

The friction coefficient is based on the relative surface finish and the empirical relationship established by Nicuradse (Reference 2).

$$\lambda = \frac{1}{(.8685 \ln (\frac{\rho_{\text{m}}}{f_{\text{S}}}) + 1.74)^2}$$

Friction loss for volute increment

$$\Delta H_{\text{fric}} = \lambda \frac{L_{\text{m}}}{2\rho_{\text{m}}} \frac{c_{\text{m}}^2}{2g}$$

The friction loss is recuperated by an increase in diffusion

$$\Delta H_{fric} = \Delta H_{vel}$$

which is achieved by a decrease in velocity or respectively, an increase in area.

Reference 2 - Eckert/Schnell, Axial and Radial Kompressoren, Springer-Verlag 1961

$$\Delta H_{\text{vel}} = \frac{c_2^2}{2 \text{ g}} - \frac{c_{2c}^2}{2 \text{ g}}$$

where $\rm C_{2c}$ is the lowered velocity corresponding to the increased or corrected area $\rm A_{2c}$. From continuity:

$$c_{2} A_{2} = c_{2c} A_{2c}$$

$$\Delta H_{fric} = \frac{c_{2}^{2}}{2 g} (1 - (\frac{c_{2c}}{c_{2}})^{2}) = \frac{c_{2}^{2}}{2 g} (1 - (\frac{A_{2}}{A_{2c}})^{2})$$

From this expression the corrected area A_{2c} is:

$$A_{2c} = \frac{A_2}{(1 - \frac{2 g \Delta H_{fric}}{c_2^2})^{0.5}}$$

NOMECLATURE

INPUT

SYMBOL	DESCRIPTION	<u>UNITS</u>	ORMAT
R6	Radius, Base Circle	In	F .
ALP6	Fluid Angle at Base Circle	Deg	F
QD	Flow Rate	gpm	F
RH0	Fluid Density	lb/cu ft	F
OMEG	Exit Diffuser Loss Coefficient	(0.20)	F
PSEX	Exit Pressure, Static	psi	F
DL	Exit Diffuser Discharge Diameter	In	F
SFS	Surface Finish	In	E
NUM	Number of Increments		I
B5	Port Width at Base Circle	In	F

INPUT FORMAT

																								•									•														•															
		•					1	4	*	3				5.		. ()				4	•	5				9		2 ()			1	67) 1-21	≥.!	0.			1		7	5			-	1	2	Ę	-	03	1	3	Sİ	٠.	ø,	. 6	ij!	Û	1				٠
																																																		١.	4,4											
	,		,	_				ję.			,	,	.		~		_			١.	_	, ,	,	1		١.	,				•			,		_										•					2,					_						
•		Í,	Ġ	>			1	7.	,	مركم	1	3	,	4		1	,			/	11	J.	4	7		Ç	1	12.	-	1		1		٠.	_	X			1	7.	1						5			1	1,	3	۷	3	5	;						
	U 1	ال د	ij	3	i i	0:	وار	ť i.	i.	3 (7 U	. Ú 135	. !				: : :	9		: :		3	.3 .j] ;			9 (3	J.	. 3	J	Ü	IJ	Ĵ	J) '	j ĝ	Û	0 (0 0	Û	0 0	į	0	0 0	0	0	0	0			0	C	8		0	0	0 1	0 0	0	
	1	1	1	Į	1	1		1	1	1.1	1	1	1	1 1	1	1	1	1	1	11	1	ï	1	1 1	1	1	11	1	1]]	1 1	1"	1	1 1	1	1	1	, ,	1	SI 1	1 1	1	1.1		1.0 5	10 60 1 1	161	62 6 1 1	1 E4	1	66 6 1	: 64 	1 69 1 1	0 /: 1 f	1 /2	13 .	14 15 1 1	16	1) 1	18 /3 1 1) EG	
	3	. "	4	•	1	, ,	1						- 1						Í							į į												1				•		1.						ł								1			-	
	۷.		Z	7	2	۷.	1	2	4.	2 1			۱	Ĺ	7	7	2 7	! 7	2	2 4	4	2	2 7	2 2	. 2	2	2	1	Ţ	2	2 2	:	2	. :	~	Ž	1:	-	2	2 2	2 2	2	2 2	2	2	. 2	2	2 2	? 2	2	2 2	2 2	2	2 2	2	2	2 2	2	2 2	2 2	2	
	3	3	3	3	3	3 3	13	3		٠,	3	3	3	3 3	!	3	(3	3	3	3	3	3 ;	3 3	Ĵ	3	3	3	3	3 :	1 3	3	3	3 3		3	1 :	3		3 3	1 3	3	3 3		3 :	3 3	3	3 3	}	13	:	3 3	3	3	7	3	3 3	3	3 :	3 3	7	
							1						- 1						- 1							(1					- 1	,		1										
																																																									4 4					
	5 :	ĵ	5	Ş	Ş	5 5	5	5	5	5 5	5	25	5	5 5	Ĵ	į	5 5	5	5	5 5	5		5 3	5	5	5 :	3 :	5	5	5 5	5	ί		5 5	ş	Ĵ.	3 3	5	5	5	5	5	5 5	ŝ	5 :	5		5 5	5	5	5 5	5	5	5 5	5	5 !	5 5	5	5 5	i 5	5.	•
																																																									6 6					
																																																								•						
	7)	1	1	7	1	1 1	1	1	7	1 1	1	1	7	1 7	1	1	1 1	1	1	;]	1	7	7 7	1	1	1	1 1	1	7	1 1	1	7	1	1 1	7	7	1 1	1	ĩ	1	1	1	1 1	7	1 7	1 7	1	11	1	1	11	1	7	1 7	7	1	7 7	1	1 1	1	7	
		8	3	3	g	2 8	9	8		3 9	8	5	9	8 8	3	3	8	8	g	â	3	3	2 9	3	ŝ	8	3	8	8	8 8	9	3	R	g		Ĥ:	9 2	· 5	į	g ç	3	Q	2 9		0 (o	2 2	٥	٥	۵ 0	۰		•	a	6 (8 8	σ.	<i>a</i> 0		٥	
	9 ('3	9	y	g	9 9	3	G	4	3 3	1 13	9	3 !	9 9	6	9	9	9	r	9 3	Ç	;	5 9	3	9	0	1 0	9	9	9 9	9	η	9 6	9	q	7	ηα	4	ŋ f	1 9	q	q	n c	Q	9.0	a	٥	αn	۵	ð	0 0	٥	0 (n	n	0 1		0 /	0 0		n	

```
77 JOH T
LDG DRIVE CART SPEC CART AVAIL PHY DRIVE
V2 MOS ACTUAL 16K CONFIG 16K
// FOR
+10C5(CARD.TYPEWRITER.KEYBOARD.1403 PRINTER.DISK)
     DIMENSION THET,(90).RADN(90).ANC(90).VD(90).CN(90).A(90).RAD(90).
    1C(60).HVEL(90).FRIC(90).HFR(90).PS(90).HFRT(90)
     LR = 2
     LW = 5
   1 FORMAT(*1*)
   2 FORMAT(42X, 'VULUTE VELOCITIES + PRESSURE DISTRIBUTION'//)
   3 FORMAT(7F8.3.E8.3.13.F8.3)
   4 FORMAT(53x, **** INPUT ****//)
   5 FORMAT(15X. 'R6'.12X, 'ALP6',12X, 'QD',14X, 'RHO',13X, 'UMEG',12X, 'PSEX
    6 FORMAT(15X. DLINE .. 10X. SFS .. 13X. NUM . 13X. B5 /)
   7 FORMAT(5X.6F15.3//)
    8 FORMAT(5X,F15.3,E15.3,115.F15.3//)
    9 READ(LR.3) R6.ALP6.OD.RHU.OMEG.PSEX.DL.SFS.NUM.B5
      IF (R6) 500.500.11
   11 WRITE(LW.1)
     WRITE(LW.2)
      WRITE(LW.4)
      WRITE(LW.5)
     WRITE(LW.7) R6.ALP6.OD.RHO.DMEG.PSEX
      WRITE(LW.6)
      WRITE(LW.8) DL.5FS.NUM.B5
    . DTHT = 360./NUM
      VDT = 0.321 * 00
      ALPR6 = ALP6/57.296
      CVOL = 360. + COS(ALPR6)/(B5 * SIN(ALPR6))
      THET(1) = DIHI
      DO 10 1=2.0UM
10 THET(1) = THET(1-1) + DTHT +
      DO 20 I=1.NUM
      RADN(1) = THET(1)/CVOL + SQRT(2,*R6 * THET(1)/CVOL)
      ANC(1) = 3.14159 + RADN(1)**2
      VD(1) = THET(1)/360. * VDT
   20 CN(1) = VD(1)/ANC(1)
      A(1) = ANC(1)
      RAD(1) = RADN(1)
      C(1) = CN(1)
      HVEL(1) = C(1)**2/64*348
      FRIC(1) = 0
      HFR(1) = 0 .
      1 = 2
   50 N = 0
      RXC = (RAD(I-1) + R6) * C(I-1)
      CONST = VO(1)/(3.14159 * RXC)
      RAD(I) = (CUNST + SQRT(CONST**2 + 4. * CONST * R6))/2.
      A(1) = 3.14159 * RAD(1)**2
      STAY = A(1)
   17 C(1) = VD(1)/A(1)
      RAD(I) = SORT(A(I)/3.14159)
      AM := 0.5*{A(1) + A(1-1)}
      RADM = SQRT(AM/3.14159)
```

```
RM = R6 + RAUM
     XLM - = RM40THT/57.296
     CM = (C(1) + C(1-1))/2.
     HER(1) = FRIC(1) *XLM * CM**2/(128.696*RADM)
     HVEL(1) = C(1)**2/64*348
     1F(N) 30.30.32
  30 SAFE = HVEL(f)
     STAY = A(I)
  35 A(I) = STAY/SQRT(1.-HFR(I)/HVEL(I))
     GO TO 17
  32 HER(I) = (SAFE - HVEL(I) + HER(I))/2
     IF (N-1) 35.35.36
  36 IF (I-NUM) 40.42.42
  40 1 = 1 + 1
     60 10 50
  42 CONTINUE
     HFRT(1) = 0
     00 60 1=2.NUM
  80 \text{ HERI(I)} = \text{HERI(I-I)} + \text{HER(I)}
     DPDIF = DMEG * HVEL(NUM)*RHU/144.
     HET = HERT(NUM) + OMEG*HVEL(NUM)
     AEX = .785*DL**2
     VEX = VDI/AEX
     HVEX = VEX##2/64.348
     PTEX =PSEX + HVEX*RHO/144.
     PTIN = PTHX + HFT*RHO/144.
     DO 70 1-1 NUM
70 PS(I) = PTIN -(HVEL(I) +HFRT(I))*RHO/144.
 101 FORMAT(////53x, **** OUTPUT ****///)
 102 FORMAT(9x, *THETA*, 10x, *RNC*, 11x, *RCOR*, 10x, *VEL*, 12X, *FRIC*, 10x,
 103 FORMAT(7F15.4)
     WRITE (L.W. 101)
     wallE(Lw.toJ) (THET(I).RADN(I).RAD(I).C(I).FRIC(I).HFRT(I).PS(I).I
    1=1.NUM1
 120 FURMATIZZZZOX. FRICTION LOSS VOLUTE
                                                       ='.F8.3.2X.*FT
 121 FORMAT(20x, FRICTION LOSS INCL EXIT DIFFUSER =+,F8.3.2x, FT'/)
 122 FORMATIZOX. EXIT VELOCITY
                                                    ='.F8.3.2X,'FT/S'/
   1)
                                                =1.FH.3.2X. PSI 1/)
 123 FORMAT(20X. TOTAL DISCHARGE PRESSURE
 124 FORMAT(20X. PRESSURE LOSS. EXIT DIFFUSER
                                                    =*.F8.3.2X.1P5[1/)
     WRITE(LW.120) HERT(NUM)
     WRITE(LW.121) HFT
     WRITE(LW.122) VEX
     WRITE(LW.123) PTEX
     WRITE(LW.124) DPDIF
     GO TO 9
 500 STOP
     END
VARIABLE ALLOCATIONS
 THET(R )=0082-0000 RADN(R )=0166-0084
                                         ANC(R )=021A-0168
                                                             VD(R )=02CE-021C
                                                                                 CN(R )=0382-0200
                                                                                                     A(R )=0436-0384
                       C(R )=0562-04EC HVEL(R )=0616-0564 FRICIR )=06CA-0618
                                                                               HFR(R )=077E-06CC
                                                                                                   PS(R_)=0832-0780
  RAD(R )=04EA-0438
                                        ALP6(R )=08EA
                                                             00(R )=08EC
                                                                               RHO(R )=08EE
                                                                                                  DMEG(R )=08F0 "
 HERT(R )=08E6-0834
                      R6(R )=08E8
                                         SFS(R )=08F6
 PSEK(R )=08F2
                       DL(R )=08F4
                                                             85(R )=05F8
                                                                               DIHT(R )=08FA
                                                                                                   VDT(R )=08FC
 ALPR6(R )=09FE
                     CVOL(R )=0900
                                         RXC(R )=0902
                                                           CONS'(R )=0904
                                                                               STAY(R )=0906
                                                                                                    AM(R )=0908
```

		PSEX		OWEG	v** 100N1 ***			,-	
			1290*0	005.0	08%•¢	000*0629	00£•+1	000*8 78	
					S8	MUM		20110	
							S48	DEINE	
		•			009*0	96	0.125E-03	094.4	
				, and the second					
	· · · · · · · · · · · · · · · · · · ·		readings representations arranged to the first two trip deliverages gar, an						
					*** 104100 ***				
		Sd v	невт	E81C	VEL	всов	ВИС	ATBHI	
		£618*S9ST	0000.0	0000*0	241-8446	0446 0			
		6679*9951	29,4864	SE10*0	244.5606 251.8666	0.2649 0.3802	547E+0	\$0.000 \$0.0000	
		1567-2529	S8£6*67	0.0128	239.2467	8074.0	£999*0	30*000	
		6951•8951 6074•4951	8186*59	0.0124	1350.452	9875*0	\$985°0	. 0000 * 0 +	
		1208*1203	0769°06 6961°64	8110-0	0845.185	68183	2,00.0	0000.05	
		1226+84981	8619*001	0*0118	\$27*989 \$490-858	1389.0	1799*0	0000.03	
		2271.6981	8685*601	9110*0	\$\$\$*1856 \$\$2*0243	9174.0	9612*0	0000.07	
		9124.6321	8717.511"=	6110.0	£116*61Z	8767.0 3088.0	£111.0	0000.69	
		9976,6421	125,1567	0.0112	217.609.712	#106*0	£028.0 2336.0	0000.001	
		1269,9123	7010.SE1	1110.0	512.4505	1096*0	6336.0	0000*001	
		S\$E1.0781	1565.8E1	0110.0	213.4148	1266.0	1996*0 9116*0	0000*021	
		1570.3442	9446.441	6010.0	511.4864	1.0425	7966*0	120.0000	
		1570.5427	149,9283	N010.0	209.653	9980 • 1	69£0°1	0000*051	
		1570.721	1881.881	7010.0	6100.TOS	1.1295	45.001	120°0000 140°0000	
		9016-0781	£091.091	9010*0	206.2267	1,1712	1.1108	0000.091	
······································	**************************************	1571,0820	1948**91	9010*0	204.6192	1.2120	1741.1	170,0000	
		1871.2460	0855.651	5010*0	2670.E0S	1.2519	1.1025	130,000	
	-	3504.1721	173.6309	9010.0	261.5836	1.2909	1715.1	0000.001	
		6799*1781	177.7126	4010.0	200-1453	1.3292	1.2509	200,0000	
		2007.1721	181 • 193	\$010°G	5457.801	1*3668	1.2839	210,0000	
•		£148,1721	5596.581	6010.0	9407.161	1504.1	1.3163	220,0000	
		8946.1721	168,9636	0.0103	101.36.1	1077.1	1.3460	510.0000	
	•	9701.S781	192,4246	2010.0	194,8333	8574.1	1646.1	240,0000	
₹;		972.2348	£887.891	2010.0	9009.501	0115*1	2605°1	520.000	
		0778.5721	2879.891 	1010.0	192,4013	1595.1	1.4398	260.000	
		0714.5721	2870.502	1010.0	1565,191	1.5800	∀ 69 †* 1	270,0000	
		1572,5930	8590.205	0010*0	£760*061	196138	5864*1	590.0000	
		1572,7055	8589.405	0010.0	188.984	1.6472	1452.1	\$10,0000	
	e,		6967.015	00100	9868.781	1.6802	#988 * 1	0 0000100€	
. •		1572,9213	213.5241	6600.0	Z868*981	8517.1	1.6432	0000 1118	
		1820.8481	216,1704	6600*0	£208°591	0374.1	7012 .1	೧ ೮૯५ ° € 7€	

VOLUTE VELOCITIES + PRESSURE DISTRIBUTION

		min-reporter - marker strendere spermatersket provinciale	and an extension and the definition of the desired and the desired and the second of t		-ta.anartaali diiyaayar Asjabati Asian-arasi	hristannika.Maeritriittiitiinijiistelist	manyment distribution from instruction his	159650e0Floor-Curbourn-villestin-Act-Ac	and the section of th	
			FRICTION LOSS VOLUTE	= 226.028	FT					
			FRICTION LOSS INCL EXIT DIFFUSI		·					
			EXIT VELOCITY	= 1121911					•	
			TOTAL DISCHARGE PRESSURE	=1586.122	PS1				1	
			PRESSURE LOSS. EXIT DIFFUSER			,				
									•	
					THE THE STATE OF T					
						4				
					an agreement of the second of					
	,						÷	•	•	
	<i>:</i>								•	
ų	 > ,			ena minima e guina en, sur de estan superillo esta midilidad dibinilida dibinilida de la libra de						
	. ,							· · · · · · · · · · · · · · · · · · ·		
				•						
	•				d. mag e tale presidenciales, in more rall middlesh facilitates duman					
		*** * * * * * * * * * * * * * * * * * *				·				
						•				
				The second secon			-			
				- · · · · · · · · · · · · · · · · · · ·	——			•		
			The second secon						*	

5. IMPELLER DISCHARGE TRAVERSE DATA EVALUATION

COMPUTER PROGRAM IMPELLER DISCHARGE TRAVERSE DATA EVALUATION

I. INTRODUCTION

This program serves for the reduction of total pressure and flow direction data obtained from surveys conducted with traversing probes at the discharge of a pump impeller. It calculates local, integrated and mass weighted impeller head coefficients as well as efficiency and slip.

The program was first used as a supplement to the Pump Air Test Data

Reduction Program (Reference 1) for the reduction of traverse data obtained from

pump air tests conducted in support of the NERVA Turbopump Program. The pump

air tests and the use of this computer program are discussed in Reference 1 and 2.

II. PROGRAM DESCRIPTION

The Impeller Discharge Traverse Data Evaluation Program consists of a short main program and a subroutine TRAVD. All major calculations are performed in subroutine TRAVD which in essence was written for incorporation into the Pump Air Test Data Reduction Program, Reference 1.

Reference 1 - J. J. Brunner, Pump Air Test Data Reduction Program, Aerojet Nuclear Systems Company, Engineering Operations Report

Reference 2 - J. J. Brunner, Performance of a Two-Stage Centrifugal NERVA Pump Tested with Air as the Working Fluid, Aerojet Nuclear Systems Company, Engineering Operations Report N8300R:71-090

III. ASSUMPTIONS AND BASIC EQUATIONS

The Traverse Data Evaluation Program calculated impeller total head coefficients directly from the measured total pressures. Exit or mixing losses at the impeller discharge and flow losses in the short radial annular diffuser section extending from the impeller discharge to the location of the probe are neglected. Previous loss calculations indicate that such losses are very small. The static pressure is assumed to be constant across the width of the port and equal to the average value of the measured wall static pressures.

The absolute velocity at each traverse position is obtained from:

$$C_{(b)} = \sqrt{2 g (H_{t_{(b)}} - H_{s})}$$

and the meridional velocity based on measured flow angle $\alpha(b)$ is

$$c_{m(b)} = c_{(b)} \sin \alpha_{(b)}$$

$$\overline{C}_{m} = \frac{\int_{0...C_{m(b)}}^{B} db}{B}$$

wherein B = housing port width.

Tangential velocity component at each traverse position:

$$C_{u(b)} = C_{(b)} \cos^{\alpha}(b)$$

Mass weighted tangential velocity component:

$$\overline{c}_{u} = \frac{o^{\int_{B} (c_{u(b)} c_{m(b)}) db}}{\overline{c}_{m}}$$

Integrated flow angle:

$$\overline{\alpha} = \tan^{-1} \left[\frac{\overline{C}_{m} B}{o^{\int_{0}^{B} C_{u(b)} db}} \right]$$

Mass weighted total head:

$$\overline{H}_{t} = \frac{o^{\int_{B}^{B} (H_{t(b)} C_{m(b)}) db}}{\overline{C}_{m}}$$

A continuity check is performed by comparing the integrated flow

$$\overline{V} = \overline{C}_{m} A$$
 (A = $2\pi R_{M} B$)

with the measured flow (corrected for recirculation when applicable).

The absolute velocity components are adjusted in subsequent computations to satisfy continuity. In these calculations the meridional velocities $C_{m(b)}$ are multiplied by the ratio of measured flow to calculated flow V/\overline{V} , assuming that the distribution of these velocities is correct and that the discrepancy in flow is due to the measured fluid angle. From adjusted velocity triangles determined by $C_{(b)}$ and $C_{m(b)}$, new values of fluid angle $\alpha_{(b)}$ and tangential velocity $C_{u(b)}$ are calculated. The mass weighted total head is not affected by this adjustment because the ratio of the local value of $C_{m(b)}$ to the integrated value \overline{C}_m remains the same.

Impeller efficiency and slip coefficient deduced from measurements are based on the mass weighted, adjusted tangential velocity component \overline{C}_{11} .

Ideal Head Coefficient ψ_i $\frac{R_2}{R_1} = \frac{R_2}{R_2}$

$$\psi_{i} = \frac{\frac{\kappa_{2}}{R_{m}} \overline{C}_{u}}{u_{2}}$$

Impeller efficiency n

$$n = \frac{\overline{H}_t}{\psi_i \frac{U_2^2}{g}}$$

Slip coefficient µ

$$\mu = \frac{\frac{R_2}{R_M}}{\frac{C_u}{tan R}}$$

where:

 C_{m2} = meridional velocity from one-dimensional analysis.

Nomenclature, input format, listing and sample printout are presented on the following pages.

NOMENCLATURE

SYMBOL	DESCRIPTION	UNITS	FORMAT
	MAIN PROGRAM CONSTANTS		
AI21	lst Impeller Discharge Area, Blocked	Sq In	
A122	2nd Impeller Discharge Area, Blocked	Sq In	8
DI21	lst Impeller Discharge Diameter	In	
DI22	2nd Impeller Discharge Diameter	In	
BET21	lst Impeller Discharge Blade Angle	Deg	
BET22	2nd Impeller Discharge Blade Angle	Deg	
Z21	lst Impeller Blade Number		
Z22	2nd Impeller Blade Number		
FSLIP	Empirical Factor, Pfleiderer Slip = .65		
SM1	lst Impeller Blade Static Moment	Sq In	
SM2	2nd Impeller Blade Static Moment	Sq In	
INPUT			
TRAVERSE E	XCURSION CONSTANTS		•
NTRA	Number of Surveys		12
POPS(J)	Ambient Pressure	psia	F
SN(3)	Rotational Speed	rpm	F
RVBL(J)	Percent Balancer Flow Simulated	%	F
VW(J)	Net Weight Flow	lb/s	F
RHOIl(J)	Fluid Density, 1st Stage	lb/ft ³	F
RHOI2(J)	Fluid Density, 2nd Stage	lb/ft ³	F
RECI1(J)	Percent Recirculation, 1st Impeller	%	F
RECI2(J)	Percent Recirculation, 2nd Impeller	%	F
PHIT(J)	Discharge Flow Coefficient, 1st Impeller		F
PHI2(J)	Discharge Flow Ceofficient, 2nd Impeller		F
TOABS(J)	Ambient Temperature	Deg F	F
TI(J)	Temperature Interstage	Deg F	F
PTI(J)	Total Pressure Interstage	Deg F	F
QDN(J)	Flow Speed Ratio	gpm/rpm	F

NOMENCLATURE (Cont'd)

SYMBOL	DESCRIPTION	UNITS	FORMAT
J	Survey Number		13
R4	Radius of Traverse Location	In	F
CAPB4	Port Width Wall to Wall	In	F
NST	Stage Number		13
NTP	Number of Traverse Points		13
TRAVERSE V	ARIABLES		
B4(I)	Distance	In	F
PT4(I)	Total Pressure	In H ₂ 0	F.
PS4(I)	Static Pressure	In H ₂ 0	F
ALP4(I)	Flow Angle	Deg	••

GX28-7327-6 U/M050 IBM FORTRAN Coding Form Printed in U.S.A. TRAVERSE DATA EVALUATION PAGE OF GRAPHIC CONCIDENCE CARD HECTRO MUMBER RESIRECTIONS DATE PUNCH CARD & HARVINE 160 BHICAHON FORTRAN! STATEMENT AS NTP INDICATES STACK AS MANY * 8 7 :) 11 12 13 14 15 16 17 18 19 26 21 22 21 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 13 41 42 43 44 45 45 47 48 49 50

DEC: 9X, 1NTGR: 4X, FROM CONTINUITY: 4X, PERCENT*/)	· T	990000
: ORMAT (8X) *FT . 6X * FT / RPM**2 * 6X * *COEFF * 6X * FT / S * * 10X *	S2 F	990000
*ALPHA 4.8X. *FLOW RATE CUFT/5" VX. *FLOW ERROR")	T	450000
OKWVI(2X**101 HEVD**3X**NOKW 101 HEV**XX**101 HEVE**CW#**TTX*		£ 50000
CORMATION 2X, INTEGRATED VALUES WITH MASS WEIGHTED TOTAL HEAD!	161	Z50000
ORMAT (F12.4, F14.2.F11.2.F13.2.F14.4)	3 41	T50000 -
E1/51.6K1CM4/U2*/)		090000
OBMAT(5X, BUTCAPBU SX, CU,FT/S, 7X, DEC. 6X, CMU, FT/S, 4X, CUL.	3 ST	650000
:ILK. PX', AEFOCILL, PX', FLOW CUEEF!)	TC TC	840000
ORMVI(\\\QX'.DIZIVMCE.'+X'.VBZ AEFOCIIX.'SX'.EFOM VMCFE.'SX'.AEFO	l C T	Z50000
ONMAT (F12.4; F13.2) F14.2.2 E13.4 F10.4 F12.4)	d TY	950000
**************************************	1	540000
OBMVI(2X*.bd\CVb8d.*2X*.HId* EI.*\JX*.HEVD.*8X*.HEVD.*8X*.HEVD.		1110000
1.4K, HORRA STAT.4K, TOT HEAD' 3X, STAT HEAD')	i t	£40000
OURNAL CXX.DISTANCE. + + X. TOTAL HEAD. + 3X. STATIC HEAD. + SX. NORM TO	- ·	00000
OMBALL SAFARCE AND THE DEAD OF THE SAFARCE TO SAFARORM TO		140000
OBMAT (2X) PARAMETERS BASED ON MEASURED WALDESTAND	. T	040000
CHEED = 11811SX14BbH18X14BVTVNCEB EFOM = 11E122SX14BEBCENI1N) CORMVI(SX11MBEFFEB DISCHVBEE	1 C	650000
ONDAY I SY, ILDEL I EP DICCHARGE, CIARE', 12, 10x, 10x, 10x, 10x, 10x, 10x, 10x, 10x	.a. #. .a. T	850000
ORMAT(\\\/\45X**TRAVERSE DATA EVALUATION*/\)	4 OT	750000
0 = 1		950000
9 - N		5 50000
(\$1) 401149, (\$1) 4114		1/20000
I(12).PTI(12).PHII(12).PHIZ(12).Z21.Z22.FSLIP.SM1.SM2.J.ODN(12).		\$50000
ECIL(12).RECI2(12).AI21.AI22.DI21.DI22.RET21.RET22.TOAN5(12).	NT	220000
OMMON POPS(12), SU(12), RVBE(12), VW(12), RWBIL(12), RW	٠, ١	150000
M4B(20), CU4B(20), HT4CB(20), CM4A(20), ALPLAN, BHOTS(12),	77	060000
H1C#(50)*H2C#(50)*H1C#(50)*C#(50)*CH#(50)*CH#(50)*CH#(50)*	11	620000
MENSION B4(20) 414(20) 414(20) 424(20) 4144(20)	ຕໍ້	000000 g
(08) 402H-(08) 401H-(08) 401H-(08) 402H-(08) 401H-(08) 401H-(08)	<u> </u>	7 20000.
GNV61 2H11H0GH		000005
40T		\$20000
VEL TRAVE		00005#
A8114.1≡C 0€ 0		000003
49.684 + (L) 28401 = (L) 28401		000055
A9141±C 0S 0		000051
ECIS(U), PRHIL(U), THIS(U), TO ABS(U), TIT(U), PTI(U), ODDU(U), ATTU-10, ODDU(U), AT		000050
EAD(5.3)(POPS(J),SW(J),WW(J),RHOIL(J),RHOIS(J),RECI1(J), EAD(5.3)(POPS(J),SW(L),VW(J),VRHOIL(J),RHOIS(J),RECI1(J),	Я	610000
ORNAT (GFIU.4/6F10.4)	4 C	810000
70-51 - SM		0000012
8.51 = IN		910000
99 · = dins		S10000
22 = 0 = 22		00000
21 = 8.		0000013
122 = 25.		000013
21.21 = 30.		110000
122 = 10.75	-	010000
30.01 = 151		600000
122 = 15.7		800000
$\frac{1}{1}$		400000
EVD(Q*T) NIBV		900000
ORMAT(11)		\$00000
(S1)APH44(S1)APH44(S1)APH44(S1)APH44(S1)APH44(S1)APH44(S1)APH44		400000
		£00000
I(IS) PHI(IS) PHII(IS) PHIS(IS) ZSI ZSS LETIP SWI PROPORTS)	AIT ·	200000
ECIT(IS) BECIS(IS) VIST VIST VISS DIST DISS FILIST BEISS 10 VBC (IS)	7	100000
OMMON POPS(12), SW(12), RWEL(12), VW(12), RHIOI1(12), RHIOI2(12))	<u> </u>	~* o`óoo

0 ELT LISTITIVO4061 35640

```
bSISF = ESFIb * (10+8EL5/00)
                                                                                                           911000
                                                                      ALEN = PSTHAZPSIEU
                                                                                                           STIMMO
                                                                PSIHA = PSIO - PHID/TGR2
                                                                                                           911000
                                                                    baille = ache * bairn
                                                                                                           000113
                                                                                                           000115
                              b210=EXb(-5**0*21N(5**0)\5)*EXb(\)\((5**C)**(#**C**5\5))
                     V=0.5797*C**42/Z**2-19.233*C**4/Z**3-18.65844/Z**44.64(8.*C**44/Z**44.64(8.*C**2-1.5)
                                                                                                           111.000
                                                                                                           011000
                                                                               (9)500 = 0
                                                                                                           601000
                                                                 e = (90 - 8E12) / 57.295
                                           SCHS = 1' - I'VESIED * 2'IHIL * SIN(BEISB)\S
                                                                                                           801000
                                                                  PSIEU = 1. - PHID/16B2
                                                                                                           101000
                                                                                                           901000
                                                            1005 = 2IM(BE158) \setminus CO2(BE158)
                                                                                                           901000
                                                                     BEISK = BEIS\67.296
                                                                     1200 = 115**5\25*174
                                                                                                           #NTOOO
                                                                   84 U2 = SN(J) * DI2/229.
                                                                                                           000103
                                                                                                           nonros
                                                                     \Lambda t = \Lambda M(\Omega) \setminus \text{KHOIS}(\Omega)
                                            \Lambda IS = \Lambda M(1) * (I*+BECIS(1)\setminus IOO*)\setminus BHOIS(1)
                                                                                                           contor
                                                                          FILE = PHIS(4)
                                                                                                           neteen
                                                                                                           660900
                                                                                 ZWS = WS
                                                                                                           860000
                                                                                  S = SSS
                                                                                                           460000
                                                                             BELS = BELSS
                                                                               SSIA = SIA
                                                                                                           960000
                                                                               35 DIS = DISS
                                                                                                           960000
                                                                                                           660000
                                                                                 t/6 01 09
                                                \Lambda t = \Lambda M(3) * (1*+B\Lambda BF(3) \times 100*) \times BHOII(3)
                                                                                                           260000
                                             AIS = AM(1) * (1*+KECIT(1)/100*)/KH01T(1)
                                                                                                           260000
                                      (C)IIHa = OIHa
                                                                                                           160000
                                                                                                           060000
                                                                                 IWS = WS
                                                                                                           690000
                                                                                  727 = 7
                                                                                                           880000
                                                                             1ST38 = ST38
                                                                               VIS = VISI
                                                                                                            180000
                                                                                                                    0
                                                                               60 DIS = DISI
                                                                                                           990000
                                                                       IE (M21-T) 80180185
                                                                                                           ceasana
                                      BEVD([B'12]) (8#(I) b1#(I) b8#(I) VFB#(I) (14/11)
                                                                                                           900000
                                                          BEVD(FB+VI) 1'SH+CVBBH+NZI+NIE
                                                                                                           £90000
                                                                                                            0000005
                                                                      OF FORMAT(F10.2 F13.2)
                                                                                                            THORNE
                                                           RO LORMVIC BX : LET/S: . DX : LET/S: ()
                                                             87 FORMAT(V/6X, U2: 11X, CM2!)
                                                                                                           090000
                                         82 EOMMV1(SX) INDEFFER EREICIENCA, FESTON 43ESUOT)
                                                                                                           670000
                                                       92 EGREVIC SX**2FIB***E30*#*2ES0*#\\)
                                                                                                           870900
                                                                                                           420000
                          61 EOBWY1(\SX*+6VBVWELEBS BVSED+\SX*+0N VBOAE COEEFICIENIS+\\\)
                                                                                                           970003
                                                            79 FORMAT (F10.4+F15.0+4F20.4)
                                                           T.BETEIDEGEB. TOX . WEV20BED. ()
                                                                                                            970000
                    11 FORMAL EXPIRED COEFF, RX. FULER FIRE PARTIES FACOSIA FURX FSTODOLA FIRE
                                                                                                            670000
JE EORMVI( POX: INFORETICAL HEAD COEFFICIENTS!/)
                                                                                                           240000
                                                                                                            90000
                                                                       73 FORMAT(F6.3.3F8.2)
                                                               AL FORMAT(I3.F7.3.F10.3.213)
                                                                                                            170000
                                                        47 FORMAT (F22.2.2F10.2.F33.2.F16.2)
                                                                                                            020000
                         #P EOGMVI(FBX+1E1\21*PQX .DEC+1PX+1E1\21*S6X+1E1\21*ISX+1E1\21\\]
                                                                                                            690000
                                                                                                            090008
                       #3 EOBWYLLTBX**CW #1º#X**VPPHA #104X**CU #1029X**CU #12X**CU Z*)
                                                                                                            490900
                                                        TENTIVE VELOCITY COMPONENT CUIVA
                    ## FORMATION 2X** ADJUSTED VALUES INTEGRATED. 31X* MASS WEIGHTED TANG
                                                                                                            990004
                                             (/h*934.=
                                                                          36 FORMATISK, SLIP
                                                                                                            990000
                                             37 FORMAT ( SX* ABSOLUT FLUID ANGLE = .. F6.34)
                                                                                                            1/20000
                                                  32 EOUWVI(XX SX* INGEFFER BERFORMANCE*XX)
                                                                                                            640000
                                                   33 FORMAT(F12.4.F10.2.F10.2.F10.2.F12.4)
                                                                                                            900000
                      27 EORGVIC 2X148H\CVERH412X14EI\2,19X14DE0419X14EI\2,12X1CWH\NS4\)
                                                                                                            Tennen
                                                                                     TEEE+)
                                                                                                           090000
                    SO EGMMATE SX**DISTANCE**SX**CM #**#X**ALPHA #**#X**CA #**SX**FLOW CO
                                                                                                           650300
                                                                                                           35,0000
                                 SV FORMAT(V/2X**ADD-051ED VALUES TO SATISFY CONTINUITY*VA
                                                                                                           Z50000
                          E15'3'E15'2'E13'2'E10'2)
                                                         25 FORMAT (F12.2.F14.4.F10.4) F12.2.
```

```
PSL = PSISL*(DI2/2+)**2/Z/SM ...
0000117
                    SLPP = 1./(1.+PSL)
000116
                    PSTHP = SLPP * PSTEU
000119
               C-PARAMETERS BASED ON MEASURED VALUES
000120
                    DO 110 I=1:NTP
000121
                    R4(I) = 34(I)/CAPB4
000122
                    PT4(I) = PT4(I)/27.67 + P0PS(J)
000123
                    PS4(I) = PS4(I)/27*67 + POPS(J)
000124
                    IF(NST=1) 96,96,97
000125
                  96 HT4(1)=186.768*TOABS(J)*((PT4(1)/POPS(J))**0.283 - 1.)
000126
                    HS4(I)=186.768*TOABS(J)*((PS4(I)/POPS(J))**.283 - 1.)
000127
                    GO TO 98
000128
                  97 HT4(I) = 186.768*(TI(J)+459.67)*((PT4(I)/PTI(J))**0.283-1.)
000129
                    HS4(I) = 186.768*(TI(J)+459.67)*((PS4(I)/PTI(J))**0.283-1.)
000130
                  98 HING(1) = HT4(1)/SN(J)**2
000131
                    HSU4(I) = HS4(I)/SN(J)**2
000132
                    HTC4(I) = HT4(I)/USOG
000133
                    HSC4(I) = HS4(I)/USQG
000134
                    HV4(I) = HI4(I) - HS4(I)
000135
                     C4(1) = 8.0217 + SGRT(HV4(1))
000136
                     CM4(I) = C4(I) * SIN(ABS(ALP4(I)/57.296))
000137
                    IF(ALP4(I))95,100,100
000138
                  95 \text{ CM4}(I) = -\text{CM4}(I)
000139
                 100 \text{ PHI4}(I) = CM4(I)/U2
000140
                 110 CU4(I) = C4(I) * COS(ABS(ALP4(I)/57.296))
000141
                     WRITE(LW, 10)
000142
000143
                     WRITE (LW. 1)
                    WRITE(LW.3) NST.QDN(J).SN(J).RVBL(J)
000144
                     WRITE (LW.5)
000145
                     WRITE (LW.7)
006146
                     WRITE (LW.9)
000147
                    WRITE(LW, 11) (B4(I), HT4(I), HS4(I), HTN4(I), HSN4(I), HTC4(I), HSC4(I),
000148
                    11=1,((TP)
000149
000150
                    WRITE (LW, 13)
000151
                     WRITE (LW, 15)
                     WRITE(LW,17) (B4(I),C4(I),ALP4(I),CM4(I),CU4(I),PHI4(I),I=1,NTP)
000152
               C-TRAVERSE INCREMENTS
000153
                     LIM = NTP-1
000154
                     DB(1) = 0.5 * (B4(2) + B4(1))
600155
                     DB(HTP) = 1. - 0.5 * (B4(NTP-1) + B4(NTP))
000156
                     DO 102 I=2.LIM
066157
                 102 DB(I) = (B4(I+1) - B4(I-1))*0.5
000158
000159
                     SUM = 0
                     DO 104 I=1+NTP
000160
                 104 \text{ SUM} = \text{SUM} + \text{DB(I)}
000161
               C-INTEGRATED VALUES
000162
                     SCM4B = 0
000163
                     5CU4B = 0
000164
                     SCUV4 = 0
000165
                     SHT48 = 0
000166
                     DO 106 I=1.NTP
000167
                     CM4B(I) = CM4(I) + OB(I)
000168
                     SCM4B = SCM4B + CM4P(I)
000169
                     CU4B(I) = CU4(I) * DB(I)
000170
                     SCU4B = SCU4B + CU4B(I)
000171
                     SCUV4 = SCUV4 + CM4B(I) * CU4(I)
000172
                     HT4CB(I) = HT4(I) * CM4B(I)
000173
                 106 SHT4B = SHT4B + HT4CB(I)
000174
                     HT41 = SHT48/SCM4B
000175
                     HT4IN = HT4I/SN(J)**2
000176
```

000177	HT41C = HT41/U506	
000178	CU41 = SCUVA/SCM43	t the strategy density of the summaries of the strategy of the
000179	ALP41 = ATAN(SCM4B/SCU4B)+57+296	
000180	VI4 = 0.043634 * R4 * CAPB4 * SCM4B	والمراجع المراجع المراجع المراجع المراجع المراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع
000191	$EKIC = (A14-A4) \times A4 + 100$	
000182	FLADJ = V4/VI4	
000193		
000184	WRITE(LW.21)	
00018 5 000186	WRITE (LW, 23)	
000188	WRITE(LW,25) HT41+HT4IN+HT4IC,SCM4B, ALP41,VI4,V4,ERR C-ADJUSTED VALUES	e serigen i i en en engangana i prompomentaposproprio, majo pagangan a e e e i empere spaticio militares e i errore.
000187	DO 114 THIANTO	
000133	CM4A(I) = FLADJ * CM4(I)	v en
000190	PHI4A(I) = CM4A(I)/U2	man produktivnen i kom armegener i mograpagnagnar. Or han gen pagemenagnagnar ver ei verhäldelengige år gledom på en som en ere
000191	ALP4A(1) = ASIN(ABS(CM4A(1)/C4(1)))*57.296	
000192	IF(CM4A(I)) 112,114,114	
000193	112 ALP4A(I) = -ALP4A(I)	e en en 18 eu despuis de la commente de la company de la c
000194	114 CU4A(I) = C4(I) * COS(ABS(ALP4A(I)/57.296))	
600195	WRITE (LW.27)	en e
006195	Angel Company WRITE (LW, 29)	
000197	write (Lw.31)	₩
. 000193 . 000199	WRITE(LW.33) (B4(I),CM4A(I),ALP4A(I),CU4A(I),PHI4A(I),I=1.NTP)	The second of th
000199	C-ADJUSTED VALUES INTEGRATED SCMAB = FLADJ * SCM4B	
000200		
000202	SCU4A = 0 CUV4A = 0	manan mengapakan dan dan dan dan dan dan dan dan dan d
000203	DO 116 I=1.NTP	•
000204	SCU4A = 5CU4A + CU4A(I) * DB(I)	
~ 0co205 ~	CM4BA = CM4B(I) * FLADU	mentana taka bahara salapranaka ini ji sasari sigi salapaka sa taka anga sa saksa sa sigi sa sa sa sa sa sa sa
000206	116 CUV4A = CUV4A + CM4BA * CU4(I)	
000207	CU4AI = CUV4A/SCMAB	
000208	ALPIA = ATAN(SCMAB/SCU4A) * 57.296	
000209	CM2 = VI2/AI2 * 144. CU2 = 2. * R4/DI2 * CU4AI	
000210	CU2 = 2. * R4/DI2 * CU4AI ETAIA = HT41C/PSTHA	Zonos approvincias establicados establicas para establicas en establicas provincias en el establica de establic
000211	ETAIN = HT41C/PSTHN ETAIS = HT41C/PSTHS	
000212		
- 000214	ETAIP = HT41C/PSTHP PSTHM = CH2/U2	per parago anticologista companya per a cultura de companya de la companya del la companya de la
000215	FTAIM = HT4IC/PSTHM	
000216	CUZE = U2 - CM2/TGB2	
000217	SLIPM= CU2/CU2E	and the second s
000218	WRITE (LW.41)	
000219	WRITE (LW+43)	
000550	WRITE (LW.45)	
000221	WRITE(LW,47) SCMAB.ALPIA.SCU4A.CU4AI.CU2	
00022 2	WRITE (LW, 35)	
000223	WRIFE (LW-75)	
000224 000225	WRITE(LW,77) WRITE(LW,79) PHID,PSIEU,PSTHA,PSTHS,PSTHP,PSTHM	
000223	WRITE (LW/81)	
000220	MOTTE (I M. D.3.) EL DA. CLOC. CLOD. CLITOM	
000228	WRITE(LW/85) ETAIA/ETAIS/ETAIP/ETAIM	
000220	WRITE (LW.B7)	
000230	WRITE(LW,89)	
000231	WRITE(LW,91) U2.CM2	
000232	RETURN	
000233	END	•

	Albert St. Lander	Sales and the sales and the sales and the sales are sales and the sales are sales and the sales are sales	, , , , , , , , , , , , , , , , , , ,							Desir Marie de Marie
		w		···· (. ,					•
٠				~.	en e		To the state of th			
						•				
			TRAVERSE	DATA EVALUATI	014		, , , , , , , , , , , , , , , , , , , ,			
IMPELLED DISC	ARGE, STAGE	1 Q/N	= .2185	SPEE0_=	7002.0 RPM	EALA!	NCER FLOW = 15	.215 PER	CENT	
PARAMETERS BAS	SED ON MEASURE	ED VALUES			a Marie de sité : de rée le subset de la fondamenta		,			•
DISTANCE	TOTAL HEAD	STATIC HEAD	NOUM TOT	NORH STAT	TOT HEAD	STAT HEAD			4	
EB/CAPIDA	HT4, FT	HS4 FT	HEAD	HEAD	COEFF	COEFF	6 			
.0728	2222.89	1500.17	.4534-04	.3069-04	.6380	.4306				
.1567	2216.37	1560.17	.4521-04	3660-04 3660-04	.6361	.4306 .4306				
.3175 .4762	2190.32 2183.89	1500.17 1500.17	.4454-04	.0009-04	.6268	•4306				
6.37.0	2151.29	1500.17	4308-04	.3060-04	.6174	.4306				
.7757	2056.71	1500.17	.4175-04	.3060-04	.5874	.4306				
.9524	1928.82	1500.17	.3931-04	.3060-04	•5536	.4306		•		
			· · · · · · · · · · · · · · · · · · ·		and the second s				,	
DISTABLE	AND VILLACITY	A ELON VICLE	VILINCTTY	VELOCITY'	ELOW COFFE			•		
		Y FLOW AMGLE	Mu. FTZS	CUIL FIZS	CW0\US					
TUIT CAT OF	£477 (73		.,,,		• • • • • • • • • • • • • • • • • • • •					
.0794	215.65	7.80	29,27	213.66	.0874		•			
.1567	214.68	9.00	33,58	212.03	.1003				•	
.3175	210.74	10.90	36.59	207.53	.1093		• •			
.4762	209.79	11.30	41.10	205.67	.1227					
•6343	204.63		39.76	200.78	.1187				•	
•7937	187.53	7.50	24.48	185.93	.0731					
•9524	166.09	-2.00	-5.80	-165,98	-,0173		grande grandaden og tilger i danske til den sært	·		
INTEGRATED VAL	UES WITH MASS	S WEIGHTED TOT	AL HEAD							
na material is a service of						•	· .			
TOT HEAD	NORM TOT HO	TOT HEAD	CN14	ALPHA_9	ELOW RA	ATE CUFT/S	FLOW ERROR	<u> </u>		
FT	FT/RPM++2	COEFF	FT/S	DEG	INTER FRO	OM CONTINUITY	PERCENT			
2175.38	.4437-04	.6244	29.27	8.380	4.587	4.095	_12.015			
			•							
יסאופובט אערמו	S TO SATISEY	CONTINUITY			n againe makana kerujaharan karajaran menadara menadaran di ram	an grave - populari santa na esta de maio de distribuir de la compansión d			-	
DISTANCE	CM 4 AL	PHA 4 CU 4	FLOW COE	.ee	•		-			
BAYCAPB4	FT/S	DEG FT/S	CM4/U2	· L						
.0798	26.13	6.96 214.00	.0780							
1507		0.03 212.57								
		8.92 203.19	•0976	•		•				
• 0 1 1 0										
.3175 4762	_36.69 <u></u> 1									

.9524 ADJUSTED VALUES		-1.79	166-00								
ADJUSTED VALUES	· INTEGRA			_,0155		•			- /		
		TED		musik makan ki mi makamanan mindakan dalah sarah	MASS WEIGHTS	ED TANGE	ENTIAL VELOCITY	COMPONENT CU	and the second second second second	er ang spensor - de desa spensor von	
	CM 4	ALPHA 4	CU 4 FT/S	· · · · · · · · · · · · · · · · · · ·	· Ct	U 4	CU 2				
	26.13	7.47	199,25	raggarage ng ammanganan na yaon da 10 ghal	. 205	5.18	213.62	garra mad spyringgravnya plategravy a chandry daily statement No - my - e - me		papage a magnina ny sia day a miandagenia sian	
MPELLER PERFOR	MARICE				en e				A property of the state of the state of the	r Jennes reggerende i v. er er beger rende sek res	
		end anymous species of species blanches related		THLORET	ICAL HEAD COEFF	FICIENT	S		Charles of the second second second	n mani ngun gan nunnan nu	
TLOW CREFF	EULER	•	ACUSTA		STODOLA		PFLEIDERER	MEASURED)		
.1053	.8167		•6328		.6204		.6354	.6380			.,
ARAMOTERS HASE H ABOVE COOFFI			. 1						***		
21h	La distanti a distanti di suomenti di s	na waa maran ay ma ay wa	.7748		.7596		.7780	.7828	and the second of the second of the second of		
MPELLERTEFFICI	EHCY		•9866		2.0064		•9826	•9780		······································	e gragae se
U2 FT/S	CM2 FT/S	,									
334.81	35.76						Name of State of Stat	·			
										· · · · · · · · · · · · · · · · · · ·	
					5						
			13.					The second secon		3.	

6. PUMP AIR TEST DATA REDUCTION

COMPUTER PROGRAM

PUMP AIR TEST DATA REDUCTION

I. INTRODUCTION

This program computes overall as well as component performance parameters of a two-stage centrifugal flow pump from measured data including pressures, temperatures, torque and shaft speed. Calculations of isentropic head and air density account for changes in relative humidity.

The program was written for the reduction of test data obtained from pump air tests conducted in support of the NERVA Turbopump Program. The pump air test results are discussed in Reference 1.

II. BASIC EQUATIONS

1. Pressure Conversion

The following conversion factors are used in the program:

1 PSI = 2.036 in. Hg

1 PSI = 27.67 in. H_2O

Reference 1 - J. J. Brunner, Performance of a Two-Stage Centrifugal NERVA Pump Tested with Air as the Working Fluid, Engineering Operations Report M8300R:71-090, 12-9-71

2. Air Properties

Measured are barometric pressure B in in. Hg and wet and dry bulb temperature $t_{\rm W}$ and $t_{\rm d}$ from psychrometer. The vapor pressure ${\rm P}_{\rm W}$ in in. Hg corresponding to the wet bulb temperature $t_{\rm W}$ is obtained from the steam tables. The actual vapor pressure ${\rm P}_{\rm V}$ in in. Hg is calculated from the empirical equation presented in Reference 2:

$$P_{v} = P_{w} - \frac{B(t_{d} - t_{w})}{2700}$$

The relative humidity r_h is the ratio of the actual vapor pressure to the pressure of saturated vapor at the prevailing dry-bulb temperature:

$$r_h = \frac{P_v}{P_d}$$

Neglecting the inert gases, the part pressures of the oxygen-nitrogen-water vapor mixture are calculated according to Dalton's Law.

Reference 2 - L. S. Marks, Mechanical Engineers' Handbook, Fifth Edition, McGraw-Hill Book Co., 1951

The pressure of dry air p_a is:

$$p_a = B - P_v$$
 (in. Hg)

and that of its constituents:

$$P_{0_2} = -.21 p_a$$

$$P_{N_2} = .79 p_a$$

The density ρ of each constituent is obtained from:

$$\rho = \frac{MP}{1546 T}$$

M = molecular weight

 $P = pressure in 1b/ft^3$

T = absolute temperature °R, (dry bulb)

The specific heats of the mixture are obtained by weighting the specific heat of each constituent as follows:

$$c_{p} = \frac{\rho_{0_{2}} c_{p_{0_{2}}}}{\sum \rho} + \frac{\rho_{N_{2}} c_{p_{N_{2}}}}{\sum \rho} + \frac{\rho_{V} c_{p_{V}}}{\sum \rho}$$

بتمنيتم وتحبر الشاعي المانيا المراساتين

The specific heat C_{V} is calculated analogously. Values of specific heats for each constituent used in the program are summarized below.

SPECIFIC HEATS IN BTU/(LB, "R)

3458.	944.	H ^S O
EYT.	5244	S ^N
SST.	712.	₂ 0
^ ₂	C ^b	

The mixture density is equal to the sum of the densities of the consti-

squenq:

$$V^{Q}$$
 + S^{Q} + S^{Q} = Q

gas constant:
$$R = 778.2 (C_p - C_v)$$

Molecular Weight:
$$M = \frac{1546}{R}$$

Flow Measurement

The following equations apply for all flow nozzles employed:

Nozzle constant
$$K = \phi C$$

$$C = \text{velocity of approach factor} = \sqrt{\frac{1}{l} - (\frac{2}{h^2})}$$

$$A_{S}$$
 = nozzle throat area, sq. in.

The compressibility effect is considered with adiabatic expansion factor Y, from Reference 3.

$$Y_{a} = \left[r_{p}^{\left(\frac{2}{\gamma}\right)} \left(\frac{\gamma}{\gamma-1}\right) \left(\frac{1-r_{p}}{1-r_{p}}\right) \left(\frac{1-\beta^{4}}{1-\beta^{4}}r_{p}^{2}\right)\right]^{1/2}$$

 r_p = pressure ratio across nozzle: P_{noz}/P_{line}

 γ = ratio of specific heats C_p/C_V

= ratio of throat to pipe diameter

Volumetric Flow Rate V_f

$$V_f = K (Y_a) \frac{A_2}{144} (\frac{2g}{\rho} \frac{144 \Delta P}{27.67}) = 0.127 K A_2 (\frac{\Delta P}{\rho})$$
 (ft³/sec)

where:

$$\Delta P = P_{pipe} - P_{throat}$$
, in H₂0

 ρ = Fluid density, $1b/ft^3$

Reference 3 - ASME, Fluid Meters, Fifth Edition, ASME, New York, 1959

$$H_{is} = 778.2 C_p T_o \left[\left(\frac{P_2}{P_o} \right)^{\frac{\gamma - 1}{\gamma}} - 1 \right]$$
 (ft)

In this calculation of the overall and stage total head rise, the velocity head

$$H_{\text{vel}} = \frac{\left(\frac{144 \text{ V}_{\text{f}}}{\rho \text{ A}}\right)^{2}}{2g}$$

is added to obtain the correct total head.

6. Pump Efficiency

Efficiency based on measured temperature rise Δt_{act}

$$n_t = \frac{\Delta t_{is}}{\Delta t_{act}}$$

where:

$$\Delta t_{is} = T_0 \left[\left(\frac{P_2}{P_0} \right)^{\frac{\gamma - 1}{\gamma}} - 1 \right]$$

Efficiency based on measured shaft torque τ (in 1b)

$$n_{\tau} = \frac{12 \text{ W} \quad \Delta H_{is}}{\omega \tau}$$

W = net flow rate, lb/sec

 ω = angular velocity= $\frac{\Pi}{30}$ N, rad/sec

7. Labyrinth Flow Rate, Impeller Shroud

The recirculating impeller front shroud labyrinth flow rate is estimated to determine the impeller discharge flow coefficient. Mean labyrinth through flow area $A_{\bar{1}b}$ and orifice coefficient $C_{\bar{1}b}$ are input. The pressure gradient along the shroud is neglected.

$$\dot{W}_{1b} = C_{1b} \frac{A_{1b}}{144} \rho \left[\frac{2g (144) \Delta P_{1b}}{\rho} \right]^{1/2}$$

$$= 0.65847 C_{1b} A_{1b} (\rho \Delta P_{1b})^{1/2}$$

where:

 ΔP_{1b} = pressure drop in 1b/sq.in. across labyrinth

 $C_{1h} = labyrinth flow coefficient = 0.5$

8. Impeller Discharge Flow Coefficient

$$\phi_2 = 144 \frac{\dot{W} + \dot{W}_{1b}}{\rho A_2 U_2}$$

A₂ = impeller discharge area blocked, sq. in.

 $U_2 = D_2 N/229$, ft/s

For the second stage the recirculating balancer flow (when simulated) must be added to the net flow.

9. Stage Head Coefficient

$$\psi = \frac{g \wedge H_{is}}{U_2^2}$$

10. Impeller Discharge Total Head Coefficient (one-dimensional)

This coefficient is based on an average static pressure determined from several wall static pressures measured around the impeller periphery between diffuser inlet and impeller discharge at radius R_{M} . Two methods were considered for estimating the impeller total head:

Method I (based on assumed impeller efficiency)

The static head coefficient is expressed as the difference of the total head coefficient and the velocity head in coefficient form:

$$\psi_{s} = \psi_{t} - \frac{\psi_{i}^{2} + \phi_{2}^{2}}{2}$$

 ψ_{s} = static head coefficient

 ψ_t = total head coefficient

 ψ_i = ideal head coefficient

\$\psi_2 = discharge flow coefficient

Since the static head is based on measurements outside the impeller discharge the absolute velocity is reduced by the ratio of the impeller discharge radius R_2 to the radius of the pressure tap R_M . The velocity head therefore is multiplied by the radius ratio squared. Substituting the ratio of total head coefficient to impeller efficiency in place of the ideal head coefficient:

$$\psi_{s} = \psi_{t} - \left(\frac{R_{2}}{R_{M}}\right)^{2} \left(\frac{\left(\frac{\psi_{t}}{\eta}\right)^{2} + \phi_{2}^{2}}{2}\right)$$

Solving for ψ_t the quadratic equation can be written as:

$$\frac{\left(\frac{R_{2}}{\eta R_{M}}\right)^{2}}{2} \qquad \psi_{t}^{2} - \psi_{t} + \left(\frac{R_{2}}{R_{M}}\right)^{2} \left(\frac{\phi_{2}^{2}}{2}\right) + \psi_{s} = 0$$

and

$$\psi_{t} = \frac{1 + \sqrt{1 - (\frac{R_{2}}{\eta R_{M}})^{2} \left[(\frac{R_{2}}{R_{M}})^{2} + 2 \psi_{s} \right]}}{\left(\frac{R_{2}}{\eta R_{M}} \right)^{2}}$$

Method II (based on calculated slip)

In this method the impeller total head coefficient is calculated directly from

$$\psi_{t} = \psi_{s} + (\frac{R_{2}}{R_{M}})^{2} \left(\frac{\phi_{2}^{2} + \psi_{1}^{2}}{2}\right)$$

with a theoretical head coefficient ψ_i based on Stodola's slip correction, defined as:

$$\psi_i = 1 - \frac{\phi_2}{\tan \beta_2} - \frac{\pi \sin \beta_2}{Z}$$

where:

 β_2 = discharge blade angle

Z = number of blades

Values calculated by both methods showed excellent agreement for data points near design. For off-design points however, the slip estimate was considered more accurate and consistent than the estimate of impeller efficiency. Method II was therefore selected for incorporation into the program.

11. Housing Losses

Crossover and diffusion housing losses are expressed in head coefficient form as:

$$\Delta \psi$$
 (Housing) = ψ t(Impeller - ψ t(Stage)

To determine diffuser and volute losses individually, the total head at the diffuser discharge is estimated from a measured average wall static pressure and a calculated velocity head. Using Pfleiderer's criterion for slip (Reference 4) to account for flow deviation the fluid angle at the diffuser discharge is expressed as follows:

Reference 4 - C. Pfleiderer, Die Kreiselpumpen, Fifth Edition, Springer-Verlag, 1961

$$Ctg \approx_{5} = \frac{\beta_{5} + P_{\ell}}{1 + P_{\ell}} \frac{R_{2} C_{u2}}{R_{5} C_{m5}}$$

with

$$\beta_5$$
 = diffuser vane discharge angle

$$R_5$$
 = diffuser discharge radius

$$P_{\hat{k}} = \frac{\psi^1 R_5^2}{Z S}$$

where:

S = static moment of vane in meriodinal plane =
$$\frac{1}{2} (R_5^2 - R_4^2)$$

$$\psi^1$$
 = empirical factor = 0.75 (1 + $\frac{\beta_5}{60}$)

The total head at the diffuser discharge then is:

$$H_{t} = H_{s} + \frac{\left(\frac{C_{m5}}{\sin \alpha_{5}}\right)^{2}}{2 g} \quad \text{and } \psi_{t} = \frac{H_{t}}{u^{2}/g}$$

Diffuser head loss coefficient:

$$\Delta \psi_{\ell}(\text{Diffuser}) = \psi_{\ell}(\text{Impeller}) - \psi_{\ell}(\text{Diffuser})$$

Volute head loss coefficient:

$$\Delta \psi$$
 (Volute) = ψ t(Diffuser) - ψ t(Stage)

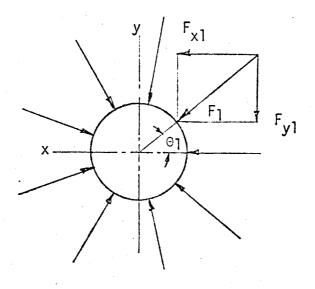
Radial Thrust

Radial thrust is determined from the wall static pressures measured around the impeller periphery. Each measured pressure multiplied by its effective area (circumferential increment x effective width) results in a force vector F shown in Figure below. The force components of F are:

$$F_V = F \sin \Theta$$

and

$$F_x = F \cos \Theta$$



The radial force \overline{F} then is the resultant of the algebraic sums of the force components F_{y} and F_{x} .

$$\overline{F} = \sqrt{\Sigma F_y + \Sigma F_x}$$

The direction of the resultant force is determined by the angle

$$\Theta = \tan^{-1} \left(\frac{\sum F_y}{-\sum F_x} \right)$$

 $\boldsymbol{\Theta}$ is measured from the pressure tap nearest to the volute tongue in direction of impeller rotation.

The radial thrust parameter used in the data presentation is defined as the ratio of the resultant radial force \overline{F} (1b) to the average static pressure rise (1b/sq in) measured from the pump inlet to the second stage impeller periphery.

$$K_{R} = \frac{F}{P_{2_{m}} - P_{amb}}$$

AIR TEST DATA REDUCTION PROGRAM NOMENCLATURE INPUT DATA

SYMBOL	DESCRIPTION	UNITS	FORMAT
IM	Month		12
ID	Day		12
IY	Year		12
NOT	Test No.		13
NODAT	Number of Data Points	•	13
NOPI2	No. of Circumferential Pressures Imp, 2nd Stage		I 5
NODF	No. of Circumferential Pressure Diff. Disch.		15
CNOZ	Coeff. Disch. Flow Nozzle		F
ANOZ	Nozzle Area	Sq In	F
ADL	Area Disch. Line	Sq In	F
CORIF	Coeff. Bleed Orifice		. F
ABL	Area Bleed Orifice	Sq In	F
	IMPELLER 1ST STAGE		
AI21	Area Imp. Disch. Blocked	Sq In	F
DI21	Diameter, Imp. Disch.	In.	F
CLAB1	Labyrinth Orifice Coeff.		F
Z21	Number of Blades		F
BET 21	Blade Disch. Angle	Deg.	F
ALB1	Flow Area, Labyrinth	Sq in	F
	IMPELLER 2ND STAGE		
AI22	Area Imp. Disch. Blocked	Sq In	F
DI22	Diameter, Imp. Discharge	In	F
CLAB2	Labyrinth Orifice Coeff.		F
7.22	Number of Blades		F
BET22	Disch.Blade Angle	Deg	F
ALB2	Flow Area, Labyrinth	Sq In	F

AIR TEST DATA REDUCTION PROGRAM NOMENCLATURE INPUT DATA

SYMBOL	DESCRIPTION	UNITS	FORMAT 4
	HOUSING		
	<u> </u>		
ACR01	Area Crossover Channel	Sq In	F
ACR02	Area Crossover Channel	Sq In	F
ACR03	Area Crossover Channel	Sq In	F
ACR04	Area Crossover Channel	Sq In	F
ADFD	Tang. Area Diff. Discharge	Sq In	F
BDFD	Diff. Disch. Fluid Angle	Deg	F
	•	•	
	MEASURED DATA		
POHG	Pressure, Ambient	In Hg	F
TO	Temperature, Ambient	Def F	F
PSD	Static Pressure, Discharge	In H ₂ 0	F
TD	Temperature, Discharge	2 Deg F	F
DPORI	Pressure Drop, Bleed Orifice	in H ₂ O	F
TI	Temperature, Total, Interstage	Deg F	F
PTI	Total Pressure, Interstage, RMR Dia.	In H ₂ 0	F
PSI	Static Pressure, Interstage	In H ₂ 0	F
SN	Rotational Speed	RPM	F
TQS	Shaft Torque, Measured	In Lb.	F
PSIM1	Mean Static Pressure, Imp Disch, 1st Stg.	In H ₂ 0	F .
PSIN	Mean Static Pressure, Inducer	In H ₂ 0	F
PCR01	Stat Pressure, Crossover Channel	In H ₂ 0	F
PCRO2	Stat Pressure, Crossover Channel	In H ₂ 0	F
PCR03	Stat Pressure, Crossover Channel	In H ₂ O	F
PCR04	Stat Pressure, Crossover Channel	In H ₂ 0	F
DPN	Pressure Drop, Nozzle Disch. Line	In H ₂ 0	F

AIR TEST DATA REDUCTION PROGRAM NOMENCLATURE INPUT DATA

SYMBOL	DESCRIPTION	UNITS	FORMAT
	IMPELLER SECOND STAGE CIRCUMFERENTIAL STATIC PR	ESSURES	•
PSI2(1)-(18)	Static Pressure, Imp. Discharge	In H ₂ 0	F
	DIFFUSER DISCHARGE CIRCUM	FERENTIAL	
	STATIC PRESSURE		
PSDF(1)-(9)	Static Pressure, Diff. Discharge	IN H ₂ 0	F

	I							FORTRAN	Coding Form								GX28-7327-6 U/M0 Printed in U.S.A.
	AZ	R TEST	DATA	REDUC	TION				FOLICIBING TECHNICITIONS	CRAPHIC						AGE G	OF
	FEET AND OFFER			······································			ATE	**************************************	1 territorial desired	вичси	l		J				5 141.4.DEV
CARD	E Carmen Screensk	: ;						FORTRAN	STATEMENT								IDETRICICATION SECURICE
1	INIDI	NOT	MODAT	NOPI2	NODE	TORY	11 12 14 1	TWEE	RHE	117	PIVET	55 AS 57 SE	59 60 61	62 63 61 65	5 AA A7 A8 A6	70 71	7) Mi 76 (A 1) 15 (2
2	ENG'Z		DNOZ	CONST	DOL		CORL		A34	1							
3	12/		0121		CLABI	FIRST	Z21	GE ZI	BET 2	r R	ALB,		1	PIII,		0.	IIIH
4	1.522	1 1	07.22		CLABZ	5.5con	Z22	THE TH	BET 2		ALB 2	2	2	32TH		01	72/7
5	11.27.45	1 1 1	ACRO:		ACR\$3	110115	ACRG NA	84	NOFO		BOFL	2	_ 2	0[2]	ep.	77	RBRG .
6	THETS	2(1) 7	4572(2)	THE	1	THEGE		Theh(s)	THETE		PRESS	· 1 · · · · · · · · · · · · · · · · · ·		(8)	THETZ	(9)	THEIZ(10)
7	733772	(11) 7.	HET2 (12) THE	2(13)	THET2(1	19/1/2	11/2/15/			45/2/	7/ 7/	ET2	(18)		1	
8	17.5416	7	10(1)		PSD (3)		DAT		OFFRE		TIC			PTILI		P	5I(I)
9			Tas C.	7	PSIM	(2)	PSIN		PERG,C	<i>I)</i>	PCRG	(2)		PCRP3	(7)_	Pe,	RC 4 (J)
10	0.24 (3	0.97	PMOT	(2)	ļ	ORE TH	ANO	NE DATA		TACK	AROS	_/					
]] [2	P5/2()) P.	12(2)	PSIZ PSIZ	To professional file	P512 (4 P512 (1	1	SI2(5) SI2(15)	PSIZ(6) P	SI 2/7	' • · •	SIZ SZZ	···· //····· } ··	PSIZ [9)	PSI 2 (10)

PSOF(1) | PSOF(2) | PSOF(3) | PSOF(4) | PSOF(5) | 1 2 5 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 22 25 26 27 28 79 30 31 32 33 34 35 35 37 36 37 A substant of a conditioner, soft electric Bid 157, is available for principle for pr

- STACK CAROS 13 74 75 76 17 79 89

PSDF(6) PSDF(7) PSDF(8) PSDF(9)
40 41 41 41 44 45 46 41 46 42 50 51 57 53 55 50 57 58 58 00 61 62 61 46 53 65 67 18 67 70 71 72

```
12 ELT MAIN, 1,720405, 49940
                                      DIMENSION PONG(30) TO(30) PSD(30) TD(30) DPORT(30) TT(30) PTT(30)
600001
                                                                                         PSIN(30) , PCR01(30) , PCR02(30) , PCR03
                                    1PSI(30), SN(30), TQS(30),
000002
                                    2(30),PCRO4(30),PSIM1(30)
000003
                                                                    TOAHS (30) RHO (30) RHOD (50) VDF (30) VOG (30)
0000004
                                     DIMENSION
                                    1VW(30) . RVRL(30) . RHOI(30) . VIF(30) . VIG(30) . PROV(30) . HISOV(30) . HOVN2(
000005
                                                    ODN(30), DTAOV(30), DTIOV(30), FFTOV(30), TOTOV(30), TONTO(30)
000006
                                    3, TONS(30), EFS(30), PRS1(30), HIS1(30), HNS1(30), OIN(30), DTAS1(30),
000007
                                    4EETS1(30),RH011(30),REC11(30),PH11(30),HC1(30),PRS2(30),HIS2(30),
800000
                                                                                                    RH012(30),PH12(30),HC2(30)
000009
                                    5HNS2(30), DTAS2(30), EFTS2(30),
                                     DIMENSION RECIZ(30). HSNW1(30). HCS11(30). SLPC1(30). HCT11(30). HTM11(
000010
                                    112),HCCRC(30),HSNW2(30),HCSI2(30),SLPC2(30),HCTI2(30),HTMI2(30),
000011
                                                    HSIM2(30), HS201(30), HS202(30), HS203(30), HS204(30), HS205(3
000012
                                    30).HS206(30).HS207(30).HS208(30).HS209(30).HS210(30).HS211(30).
000013
                                     DIMENSION HS212(30), HS213(30), HS214(30), HS215(30), HS216(30),
000014
                                    1HS217(30), HS218(30), PSDF(30), HSDFM(30), HCDHC(30), HCDFC(30),
000015
                                    2HCVOL(30), DPN(30), RELB2(30), HSNIN(30), PHF, 30), THET2(1A), YANOZ(30)
060016
                                     COMMON U. THET(18), PSI2(18), B2TH, DI21, DI22, NOPI2, NST, RAFK(30),
000617
                                    000018
                                      LR = 5
006519
065520
                                      LW = 6
                                   3 FORMAT('1')
0000021
                                   5 FORMAT (3A2, A4, 315, 3F8, 2, F8, 3)
000062
                                   7 FORMAT(*1 DATE *+A2,*-*+A2/53X,*NERVA AIR TEST*/
006023
000024
                                    152X . PERFORMANCE DATA!//)
006025
                                 11 FORMAT (53X, TEST NO. 1, A4, //)
                                 13 FORMAT (18X+ COMSTANTS 1//)
050026
                                 17 FORMAT( 2X, NOZZLE COEFFICIENT, CNOZ', 6X, F10.4, 2X, *****)
000027
                                 19 FORMAT( 2X, MOZZLE DIA, DNOZ, 13X, F10.3, 2X, SOIN!)
000028
                                 21 FORMAT( 2X, *DISCHARGE LINE DIA, DDL +,6X,F10.3,2X, *SQIN*)
000029
                                 23 FORMAT( 2X**PLEED ORIFICE COEFF, CORIF**4X*F10*4*2X*******)
000030
                                 25 FORMAT( 2X; BLEED ORIF AREA: ABL: 10X; F10:3:2X: SQIN:)
000031
                                 27 FORMATI/18X. IMPELLER FIRST STAGE . 32X. IMPELLER SECOND STAGE !/)
000032
                                 29 FORMAT( 2X, DISCHARGE AREA BLOCKED, AI21, 5X, F10.3, 2X, S9IN, 10X,
000033
                                    1'DISCHARGE AREA BLOCKED, AI22',5x,F10,3,2%,'SOIN')
606634
                                 31 FORMATI 2X. DISCHARGE DIAMETER, DI121.9X,F10.3,2X, IN. 12X,
006035
                                    1'DISCHARGE DIAMETER, DI22',9X,F10.3,2X,'IU')
000036
                                 33 FORMAT ( 2X + LABYRINTH COEFFICIENT + CLAB1 + + 5 10 x + 10 X 
000037
                                    1.LABYRINIH COFFFICIENT, CLABS: ,5X,F10.4,2X, ***)
0000038
                                 35 FORMAT( 2X, MUMBER OF BLADES, Z21',12X,F10.1,2X, ** *,10X,
000039
                                    1.NUMBER OF BLADES, Z221,12X,F10.1,2X,1 **1)
6000040
                                 37 FORMAT( 2X, DISCHARGE BLADE ANGLE, BFT21 + SX, F10.3, 2X, DFG + 11X,
000041
                                    1 DISCHARGE BLADE ANGLE, BET22 +5x + F10 + 3 + 27 + DEG +)
000642
                                 38 FORMATI 2X . LABYRINTH FLOW AREA. ALBI . AX . F10 . 3 . 2X . SQIN . 10X .
000043
                                    1.LABYRINTH FLOW AREA, ALB2.8X.F10.3.2X.50IN.
000044
 000045
                                 39 FORMAT(/53X, 'HOUSING'/)
                                 41 FORMATI 2X, CROSSOVER AREA, ACRO1 12X, F1G. 3, 2X, SOIN 10X,
600046
                                    1.CROSSOVER AREA, ACROS., 11X, F10.3, 2X, SQIM.)
006047
                                 43 FORMAT( 2X. * CROSSOVER AREA, ACRO3*, 12X. F10. 3, 2X. * SQIN*, 10X.
000048
                                    1.CROSSOVER AREA, ACRO4.11X.F10.3.2X.50INF)
000049
                                  45 FORMAT( 2X, DIFFUSER DISCHARGE AREA, ADFD', 4X, F10.3, 2X, SQIN', 10X,
000050
                                    1.DIFF DISCHARGE FLOW ANGLE, BDFD:,1X,F10.3,2X, DEG!)
000051
000052
                                 51 FORMAT (5F10.3/8F10.3/8F10.3/8F10.3)
                                 53 FORMAT (8F10.3/8F10.3/2F10.4)
000053
                                 55 FORMAT(10F8.3/8F8.3)
000054
                                 57 FORMAT (988.3)
000055
                                 59 FORMAT(61X, WIDTH, RADIAL TRHUST, B2TH, 7X, F10, 3, 2X, IN,)
000056
```

		6.444
000057	61 FORMAT(2X+*INDUCER INLET TIP DIA+ DILIT*+5X+F10+3+2X+* TH 1+10X+	
000058	1.INLET TIP DIAMETER, DISIT. BX, F10.3.2X, IN 1)	
000059	63 FORMAT(2X. INDUCER INLET HUB DIA, DILLH: 5X.F10.3.2X. IN 1.10X.	
000060	1'INLET HUB DIAMETER, DI21H'.8X' F10.3.2X' IN ')	
000061	65 FORMAT(///2x, CALCULATED CONSTANTS //)	
000062	67 FORMAT(2X, VELOCITY OF APPROACH FACTOR, FLOW NOZZLE, VLAP 10X,	
000063	1F10.4,2X,****/)	
000064 .	69 FORMAT (2X, DRAG TOROUE, TORRG , 12X, FIG. 3, 2X, INLB))	
000065	71 FORMAT(2X. ABSOLUT HUMIDITY: AHUMI-34X.F10.4)	
000066	73 FORMAT(2X, MIXTURE DENSITY, ROMIX', 34X, F; 0.4, 2X, LB/FT**3')	
000067	75 FORMAT (2X. SPECIFIC HEAT CP., 40X.F10.4,28, BTU/LB/DEG.)	
000068	77 FORMAT(2X. SPECIFIC HEAT CV. 40X. F10.4.2X. BTU/LB/DEG.)	
000069	79 FORMAT (2X, GAS CONSTANT, RMIX' , 38X, F10.4, 2X, FTLB/LB/DEG!)	
	81 FORMAT(2X. MOLECULAR WEIGHT, WMOL', 34X, F10.4/)	
000070	83 FORMATI 2X, *TDRY = **F8.2,5X, *TWET = **F8.2,5X, *REL HUMIDITY = **.	
000071		
000072	1F8.2,2X, 'PWET =',F8.3,2X,'INHG'//)	
000073	520 READ (LR.5) IM.ID.IY.NOT.NODAT.NOPI2.NODF.TDRY.TWET.RHUM.PWET	
060074 .	IF(NODAT) 990,990,530	
000075	530 READ (LR.51) CNOZ. DNOZ. DDL, CORIF. ABL, AI21, DI21, CLAB1, Z21, BET21, ALB	
000076	11,D111T,D111H,A122,D122,CLAB2,Z22,BET22,ALB2,B2TH,D121T,ACRO1,ACRO	
000077	22.ACRO3.ACRO4.ADFD.HDFD.DI21H.TQRRG	
870000	READ(LR:55) (THET2(I):I=1:18)	
000079	READ (LR.53) (PUHG(J):TO(J):PSD(J):TD(J):(DPORI(J):TI(J):PSI	
០មឲ្យនួប	1(J),SN(J),TQS(J),PSIM1(J),PSIN(J),PCR01(J),PCR02(J),PCR03(J),PCR04	
000081	2(J),DPH(J),TOMP(U),J=1,NODAT)	
2600032	WRITE(LW-3)	
60006 3	WRITE(LW.7) IM.10.1Y	
000084	WRITE(LW,11) NOT	
000085	WRITE(LW,13)	
000086	WRITE(LW,17) CNOZ	
000087	WRITE(LW,19) DNOZ	
000088	WRITE(LW,21) DDL	
000009	WRITE(LW,23) CORIF	
000090	WRITE(LW:25) ABL	
000091	WRITE(LW,69) TOBRG	
000692	WRITE(LW,27)	
000093	WRITE(LW,29) A121,A122	
000094	WRITE(LW,31) DI21.DI22	
000095	WRITE(LW, 33) CLAB1, CLAB2	
000096	WRITE(LW,35) Z21,722	
000097	WRITE(LW,37) BET21,BET22	
000098	WRITE(LW,38) ALB1,ALB2	
000099	WRITE(LW,61) DILIT,DIRIT	
000199	WRITE(LW,63) D111H,D121H	
000100	WRITE(LW,59) B2TH	
000101	WRITE(LW,39)	
000102	WRITE(LW,41) ACRO1,ACRO2	
000103	ADTTE (1 D. D.T.) ACDAT - ACDAD	
000104	WRITE(LW+45) ADFD+BDFD WRITE(LW+45) ADFD+BDFD	
	-CONSTANTS	
000106	DE210 - DET21/67, 206	
000107	TBE21 = SIN(BE21R)/COS(BE21R)	
	SLP1 = 3.1416 * SIN(BE21R)/Z21	
000109	DEF1 - 0+4410 * DIMODELE//AGI	
000110	BE22R = BET22/57.296 TBE22 = SIN(BE22R)/COS(BE22R)	
000111		
000112	SLP2 = 3.1416*SIN(UE22R)/Z22	
000113	BDFDR = BDFD/57.296	
000114	AI11 = .7854*(DI11T**2 - DI11H**2)	
000115	AI21 = .7654*(DI21T**2 - DI21H**2) ANOZ = .7854 * DNOZ**2	
000116		

000117	ARL = .7854 + DOL++2	
000118	DENOZ = DNOZZODL	
000119	VLAP = 1./SGRT(1(ANOZ/ADL)**2)	
000120	RRS01 = (DI21/11.4) **?	~ -
000121	RRS02 = (D122/11.4)**2	
000122	C-properties of Air-water vapor mixture	
000123	PVAP = PWET - POHG(1)*(TORY-TWET)/2700.	
000124	PAIR = POHG(1) - PVAP	
000125	SHUM = PVAP/1.600/PAIR	
000126	ROAIR = 1.326934 * PAIR/(TDRY + 459.67)	
000127	ROVAP = SHUM* ROAIR	
066128	ROMIX = ROAIR + ROVAP	
000129	POXY = .21 * PAIR * .49115	
000130	PNIT = .79 * PAIR * .49115	
006131	ROXY = 2.96445*POXY/(459.67 + TDRY)	
000132	ROMIT = 2.6114 *PNIT/(459.67 + TDRY)	
000133	GTOT = ROXY + RONIT + ROVAP	
000134	GOXY = ROXY/GTOT	
000135	GNIT = RONIT/GTOT	
000136	GVAP = ROVAP/GTOT	
000137	CPOXY = .217 * GOXY	
000138	CVOXY = .155 * GOXY	
000139	CVHIT = .176 * GNIT	
000140	CPNIT = .2455* GNIT	
000141	CPVAP = .44466 * GVAP	
000142	CVVAP = .33442 * GVAP	
000143	CVMIX = CVOXY + CVNIT + CVVAP	
000144	CPMIX = CPOXY + CPNIT + CPVAP	
060145	XKMIX = CPMIX/CVMIX	
0,00146	RMIX = 778.2 * (CPMIX - CVMIX)	
000147	XMMIX = 1546./RMIX	
000148	XKEXP ={XKMIX-1.)/XKMIX	
000149	C-INCREMENTS OF THETA	
006150	DO 488 I=1:NOPI2	
000151	488 THET(I) = THET2(I)	
00u152	DO 490 I=1.NOPI2	
000153	490 THET(I) = THET(I)/57.296	
000154	LIMT = NOP12 - 1	
090155	DTHET(1) = $0.5 * (THET(2) - THET(1) + 6.2834 - THET(NOPI2))$	
000156	DTHET(NOPI2)= 0.5 * (6.2834 - THET(LIMT))	
00v157	DO 492 I=2,LIMT	
000158	{ 492 DTHET(I) = (IHET(I+1) - THET(I+1)) * 0.5	
000159	J = 0	
000160	500 J = J + 1	
000161	IF(U-NODAT) 510,510,900	
000162	C-INLET CONDITION	
000163	510 POPS(J) = 0.49115 * POHG(J)	
000164	TOA(S(J)) = 459.67 + TO(J)	
000165	RHO(J) = 144. * POPS(J)/TOABS(J)/RMIX	
000166	C-PUMP DISCHARGE CONDITION	
000167	PSD(J) = PSD(J) / 27.67 + POPS(J)	
000168	PHOD(J) = 144. * PSD(J)/(TD(J) + 459.67)/RMIX	
000169	PNOZ = PSD(J) - DFN(J)/27.67	
000170	RPNOZ = PNOZ/PSD(J)	
000171	YNOZ1 = (1RPNOZ**.286)/(1RPNOZ)	
000172	YNOZ2 = (1BENOZ**4)/(1BENOZ**4 * RPNO7**1.43)	
000173	YANOZ(J) = SORT(RPHOZ**1.43 * 3.5*YNOZ1 * YNOZ2)	
000174	XKNOZ = CNOZ * YANOZ(J) * VLAP	
060175	VDF(J) = 0.12708 * ANCZ *XKNOZ * SCRT(DPN(J)/RHOD(J))	
000176	VDG(J) = 448.83 * VDF(J)	

,

```
BEVD (FB'22) (621S(I) 1=1'18)
                                                                                                                                                                                                                                                                                 0.00235
                                                                                                                                                                                                        XNOS= FLOAT(NOPIS)
                                                                                                                                        TONTO(J) = TOTOV(J)/12.5N(J)**2/RHOD(J)
                                                                                                                                                                                                                                                                                      00053#
                                                                                                             1010V(J) = 114.587 * VW(J) * HISOV(J)/SN(J)/EFTOV(J)
                                                                                                                                                                                                                                                                                    000533
                                       EFTOV(J) = DTIOV(J)/(DTAS1(J)+(10+KVBL(J))/100.))
                                                                                                                                                                                                                                                                                    000232
                                                                                                                                                                                  EFTSS(J) = DIISS \DIASS(J)
                                                                                                                                                                                                                                                                                     162000
                                                                                                                           DIISS = (11(1) + 420(1)) * ((b8SS(1)) * *XKEXE = 1.)
                                                                                                                                                                                                                                                                                     000230
                                                                                                                                                                                        (0) \text{ if } = (0) \text{ of } = (0) \text{ solit}
                                                                                                                                                                                                                                                                                    622000
                                                                                                                                                                                      HRSS(\Omega) = HISS(\Omega) \setminus 2N(\Omega) **S
                                                                                                                                                                                                                                                                                    000558
                                                                                               HISS(1) = 118.5 * (II(1) + #20.67) *(PRS2(1)**XKEXP = 1.)*CPMIX
                                                                                                                                                                                                                                                                                     7SS000
PRS2(J) = (PSD(J) + RHOD(J) * HDVEL \144.)\PTI(J)
                                                                                                                                                                                                                                                                                     922000
                                                                                                                                                                                                   C-SECOND STAGE PERFORMANCE
                                                                                                                                                                                                                                                                                     000558
                                                                                                                                                                         HCI(1) = 25^{\circ}IJd * HIZI(1)/05J**S
                                                                                                                                                                                                                                                                                     900224 B
ISUNISIAN(U) + VWLBI ) ( LOUNT + (U) WV + (U) WV + (U) VI                                                                                                                                                                                                                                                                                    000553
                                                                                                                                                                             BECII(1) = (AMFBIVAM(1)) * 100
                                                                                                                                                                                                                                                                                      000555
                                                                                                                                                                                                                              TIT(1))
                                                                                                                                                                                                                                                                                    000551
                                                                                                  \[ \frac{\Delta \cdot \c
     *ALB1*CLAD1*50RT((PSIM1(J))-PSIN(J))*RHO
                                                                                                                                                                                                                                                                                    022000
                                                                                                                                                                                                                                                                                    012000
                                                                                                                                                                                                                                                                                 000518
                                                                                                                                                                  (C)Sq0q + \Delta9.75\(C)\MISq = (C)\MISq
                                                                                                                                                                                           121 = 2N(1)*D121/256*
                                                                                                                                                                                                                                                                                   712000
                                                                                                                                                                                   000215
000816
                                                                                                                                            0.1127 = 10 \text{VE2}(1) * ((\text{LBEZI}(1)) * * \text{XKEXb} = 1^{\circ})
                                                                                                                                                                                                                                                                                  (U)0T - (U)IT = (U)I2AT0
                                                                                                                                                                       (C) IOHSY(C) OOHS * (C)NOO = (C)NIO
                                                                                                                                                                                                                                                                                     COCSIZ
                                                                                                                                                                                       HIRT(\gamma) = HIRT(\gamma) \setminus R(\gamma) \times S
                                                                                                                                                                                                                                                                                   0000315
 HIZT(1) = 118.5 * 10VB2(1)*(bBZ1(1)**XKEXI) - 1.)*CPMIX
                                                                                                                                                                                                                                                                                   112000
                                                                                                                                                                                                                                                                              0.000
                                                                                                                                                                                           255 \text{ bBST}(1) = \text{bll}(1) \setminus \text{b0bS}(1)
                                                                                                                                                                                                  C-FIRST STAGE PFREORMANCE
                                                                                                                                                                                                                                                                                    000500
HENTING) = 370.2 * TOABS(J) * (PRIN**XKEXP - 1.)/SN(J) **2*CPMIX
                                                                                                                                                                                                                                                                                   803100
                                                                                                                                                                                         PRIM = PSIM(J)/P0PS(J)
                                                                                                                                                                                                                                                                                     403960
                                                                                                                                                                       (r)Sd0d + L9.YS/(L)NISq = (L)NISq 4SB ...
                                                                                                                                                                                                                                                                                   903000
                                                                                                                                         518 1F(ABS(PSIN(U))) 522,522,524
                                                                                                                                                                                                                                                                                     902000
                                                                                                                                                                                                              C-INDOCER PERFORMANCE
                                                                                                                                                                                                                                                                                     00050#
                                                                                                  219 EFNOT(J) = HISON(J)*VW(D)N(PMOT(J)**7576 - .000727*SW(J)*TORROT
                                                                                                                                                                                                                                                                                    £03999
                                                                                                                                                                                                                                                                                    202000
                                                                                                                                                                                             1E(EMOI(U)) 518*SI8*SI9
                                                                                                                                            EES(1) = IIH \cdot EBY \cdot VW(1) \times VISOV(1) \times VSV(1) \times VSV(1)
                                                                                                                                                                                                                                                                                      consor
                                                                                                                                                            10N2(1) = 102(1)/15^{\circ} 2N(1)**5/8H0D(1)
                                                                                                                                                                                                                                                                                    002000
                                                                                                C-EFFICIENCY DERIVED FROM MEASURED SHAFT TOROUE AND MOTOR POWER
                                                                                                                                                                                                                                                                                    661000
                                                                                                                                             0110\Lambda(\gamma) = 10V82(\gamma) * (680\Lambda(\gamma) **XKEX6 - 1*)
                                                                                                                                                                                                                                                                                     000138
                                                                                                                                                                                          (U)OT = (U)OT = (U)VOATO
                                                                                                                                                                                                                                                                                   761000
                                                                                                                                                                                                 CDH(C) = ADC(C) \setminus SH(C)
                                                                                                                                                                                                                                                                                    961000
                                                                                                                                                                                                                                                                                   ~ S61000
                                                                                                                                                                              HONNS(n) = HIZON(n)\ZH(n)**5""
                                                                                                            HIZON(1) = 118.5 * 10/82(1) * (PROV(1)**(KEXP - 1.)*CPMIX
                                                                                                                                                                                                                                                                                   461999
                 261900
                                                                                                                                                                                                   C-BOWN OVERALL PERFORMANCE
                                                                                                                                                                                                                                                                                     000165
                                                                                                                                                                          PIH PII(0) = PII(0)/51.404 + POPS(0)
                                                                                                                                                                                                                                                                                    161000
                                                                                                                                                                                                                            919 01 00
                                                                                                                                                                                                                                                                                    067000
                                                                                                                                                                 bil(n) = bal(n) + BHOI(n) + HIMERNIAH*
                                                                                                                                                                                                                                                                                      691000
                                                                                                                                                                                                 HIAEF = CISI**5\01.34
                                                                                                                                                                                                                                                                                     881000
                                                                                                                                                                           215 CIST = AIE(1)/VIST * 1881/0-366
                                                                                                                                                                                                                                                                                     781000
                                                                                                                                                                                               IE(611(7)) 215'215'21#
                                                                                                                                                                                                                                                                                     OPTOOD
                                                                                                                                                                                           A10(A) = 448'82 * AIE(A)
                                                                                                                                                                                                                                                                                     SPINOO
                                                                                                                                                                           \LambdaIE(1) = (\LambdaM(1) + \LambdaMEL)/RHOI(1)
                                                                                                                                                                                                                                                                                     461000
                                                                                                                                                                                                                                                                                     £81000
                                                                                                                                      (HOI(1)) = Ith * + LOI(1) \setminus (LI(1)) + tO(1) \setminus (LI(1))
                                                                                                                                                                         (U) = PSI(U) \times V + POPS(U)
                                                                                                                                                                                                                                                                                     281000
                                                                                                                                                                                                         C-INTERSTAGE CONDITION
                                                                                                                                                                                                                                                                                     181000
                                                                                                                                                                                  RVBL(J) = 100. * VWBLVVW(J)
                                                                                                                                                                                                                                                                                     081000
                                                                                                                   HDARF = 0.12706 * ARL * CORIF * SORT(DF031(J)*RHOD(J))
                                                                                                                                                                                                                                                                                     671000
                                                                                                                                                                                                                                                                                     871000
                                                                                                                                                                                  (C) = BHOD(S) * ADE(S)
                                                                                                                                                                                                                                                                                     221000
```

```
000237
                                     100 PSI2(I) = PSI2(I)/27.67 + POPS(J)
       000238
                                            PSI2T = 0
       000239
                                            DO 102 I=1,NOPI2
       000240
                                      102 PSI2T = PSI2T + PSI2(I)
       600241
                                            PSIM2(J) = PSI2T/XN02
       000242
                                           RHOI2(J) = 144. * PSIM2(J)/(0.5 * (TD(J) + TI(J)) +459.67)/RMIX
       000243
                                                                                      *ALB2*CLAB2*S07T((PSIM2(J)-PST(J))*RH0I
                                                        = .668476
       000244
                                            VWLB2
       000245
                                          12(J))
                                                      = 5N(J) * DI22/229.
                                           U22
       000246
                                            PHI2(J) = 144.0 *(VW(J)+VWLR2 +VWRL
                                                                                                               )/RHOT2(J)/AT22/U22
       000247
                                            HC2(J) = 32.174 * HIS2(J)/U22**2
       000248
                                            RELEGIJ) = VWLBZ/VW(J) * 100.
       000249
                                            RECIZ(J) = (VWLB2 + VWRL)/VW(J) * 100.
       000250
                                            RHF(J) = (HIS1(J) + HIS2(J))/HISOV(J)
      000251
                                  C-FIRST STAGE IMPELLER PERFORMANCE BASED ON STATIC WALL PRESSURES AND
       000252
                                   C-CONTINUITY
       000253
                                            PRIS1 = PSIM1(J) / POPS(J)
       000254
                                                         = 778.2 * TOABS(U) *(PRIS1**XKEXP=1.) * CPMIX
                                           HIS#1
       000255
                                            S**(U) / (V) / (V) / (V) = (U) / (V) / (
       000256
                                            HCS11(J) = 32.174 * HJSW1/U21**2
       000257
                                            SLPC1(J) = 1.-1./(1.-PHI1(J)/TBE21) * SLP1
       000258
                                            HCTH1 = 1.- PHI1(J)/ TRE21 - SLP1
       000259
                                            HCTI1(J) =0.5*RRSQ1 *(PHI1(J)**2 + HCTH1**2) + HCSI1(J)
       u00260
                                            HTNI1(J) = HCTI1(J)+DI21**2/1687236.
       000261
                                   C-CROSSOVER CHANNEL
       600262
                                            IF(PCR01(J)) 105,105,103
       006263
                                      103 PCRO1(J) = PCRO1(J)/27.67 + POPS(J)
      . 000264
                                            PCRO2(J) = PCRO2(J)/27.67 + POPS(J)
       000265
                                            PCRO3(J) = PCRO3(J)/27.67 + POPS(J)
       000266
                                            PCRO4(J) = PCRO4(J)/27.67 + POPS(J)
       000267
                                            PCRO1(J) = 778.2 * TOARS(J)*((PCRO1(J)/POPS(J))**XKEXP-1.)*CPMIX
       000268
მ.
მ
                                            PCRO2(J) = 778.2 * TOARS(J)*((PCRO2(J)/POPS(J))**XKEXP-1.)*CPMIX
       000269
                                            PCRO3(J) = 778.2 * TOAPS(J)*((PCRO3(J)/POPS(J))**XKFXP-1.)*CPMTX PCRO4(J) = 778.2 * TOAPS(J)*((PCRO4(J)/POPS(J))**XKFXP-1.)*CPMIX
       000270
       000271
                                                         = 0.5*(RHOI1(J) + RHOI(J))
       000272
                                            HVCR1 = 322.247*((VW(J) + VWDL )/PHOCR/ACRO1)**?
       000273
                                            HVCR2 = 322.247*((VW(J) + VWPL
                                                                                                    ) /RHOCR/ACRO2) **2
       000274
                                            HVCR3 = 322.247*((VW(J) + VWPL)
                                                                                                    )/PHOCE/ACRO3)**2
       660275
                                                                                                    )/PHOC!!/ACR04)**2
                                            HVCR4 = 322.247+((VW(J) + VWAL
       000276
                                            PCR01(J)=1687236.*(HTNI1(J)-(PCR01(J)+HV( P1)/SN(J)**2)/DT21**2
       000277
                                            PCRO2(J)=1687236.*(HTMI1(J)-(PCRO2(J)+HV(R2)/SN(J)**2)/DI21**2
       000278
                                            PCR03(J)=1687236.*(HTHT1(J)-(PCR03(J)+HVCP3)/SN(J)**2)/DT21**2
       000279
                                             PCRO4(J)=1687236.*(HTNI1(J)-(PCRO4(J)+HVCR4)/SN(J)**2)/DT21**2
       000280
                                     105 \text{ HCCRC(J)} = \text{HCTI1(J)} - \text{HC1(J)}
       000281
                                   C-SECOND STAGE IMPELLER PERFORMANCE BASED ON STATIC WALL PRESSURES AND
       000282
                                   C-CONTINUITY
       000283
                                             PRIS2 = PSIM2(J)/PTI(J)
       000284
                                                                       *(TI(J) + 459.67) * (PRTS2**XKEXP - 1.)*CPMIX
                                             HISW2 = 778.2
        000265
                                             S**(U) //3/SW2/SH(U) = HISW2/SN(U) **2
        000256
                                             HCSI2(J) = 32.174 * HISW2/U22**2
       000287
                                             SLPC2(J) = 1.-1./(1.+PHI2(J)/TBE22) * SLP2
        000288
                                             HCTH2 = 1.-PHI2(J)/TBE22-SLP2
       000289
                                             HCTI2(J) =0.5*RRSQ2 *(PHI2(J)**2 + HCTH2::*2) + HCSI2(J)
        000290
                                             HTNI2(J) = HCTI2(J) * DI22**2/1687236.
        000291
                                    C-SECOND STAGE IMPELLER CIRCUMFERENTIAL PRESSURE DISTRIBUTION
        000292
                                             DO 104 I=1.NOPI2
        000293
                                       104 PSI2(I)=778.2 *(TI(J)+459.67)*((PSI2(I)/ PTI(J))**XKEXP - 1.)
        000294
                                            1" * CPMIX + HIS1(J)
        000295
                                             HSI2T = 0
        000296
```

and the second of the second of

		the state of the s
000297	00 106 I=1.NOPIS	
000598	106 HS12T = HS12T + PS12(1)	The state of the s
000299	HS12 = HS12T/XN02	
000300	DO 108 I=1.NOPI2	the state of the s
000301	108 PSI2(1) = PSI2(1)/HSI2	
000302	HSIM2(J) = HSI2 /SN(J)**2	
000303	HS201(J) = PSI2(1)	
000304	HS202(J) = PSI2(2)	
000305	DC3/2/ D = DC13/3)	
000306	HS204(J) = PSI2(4)	en de la companya del companya de la companya del companya de la companya del la companya de la
000307	HS205(J) = PSI2(5)	
000303	HS206(J) = PSI2(6)	
000309	HS207(J) = PS12(7)	
000310	HS208(J) = PS12(8)	
056311	HS209(J) = PSI2(9)	
000312	HS210(J) = PSI2(10)	The part of the last transport to the last t
000313	HS211(J) = PS12(11)	·
006314	HS212(J) = PS12(12)	
_ 000315	H5213(J) = PS12(13)	
00u316	115214(J) = PS12(14)	
000317	HS215(J) = PS12(15)	
900318	HS217(J) = PS12(17)	
000319	HS217(J) = PS12(17) HS218(J) = PSI2(18)	
600320	MSZ18(O) = PS12(16)	
000321	IF (NOPI2-3) 109,109,111	
006322 00032 3	111 CALL RATHR	
000324		The state of the s
000325	109 READ (LR.57) (PSDF(I).I=1.9)	
000326	00 110 T-1 NODE	
000327	110 PSDF(I) = PSDF(I)/27.67 + POPS(J)	
000328	DO 128 T=1.80DE	
006329	120 PSDF(I) = 778.2 *(TI(J)+459.67)*((PSDF(I)/PTI(J))**XKEXP=1.)*CPMI
000330	1X	
- CUUS31	HSDFT = 0	
06u332	DO 122 I=1.NODF	
000333	122 HSDFT = HSDFT + PSDF(I)	A CONTROL OF MARKET AND CONTROL OF THE CONTROL OF T
C00334	XMODE = FLOAT (MODE)	
000335	HSDEM(J) = HSDET/SN(J) **2/XNODE	IDEPERS DEVIATION CRITERION
0vu336	C-DIFFUSER DISCHARGE ANGLE MASEN ON PFLE.	IDEALIS DEALVILON CALLACION
000337	CM32 = 1444 7 VM (07) (100 107) (100 107)	100011
090338	CUTH2 = U22*(1.+PHI2(J)/TBE22) * S	H2/CM521)
000339	HVUF = .975 * (CM52/SIM(AL52R))**2	16 / Chi.
000340	BIGGO - BONEWALD + RVDF/SN(J)**2	
060341	$\frac{\text{HTMDF} = \text{HSDFM(3)} + \text{HVMF7SH(3)} + 2}{\text{HCDHC(J)} = \text{HCTI2(J)} - \text{HC2(J)}}$	The control of the second of the control of the con
000342	HCDF = 1687236./DI22**2 * HTNDF	
000343		
000344	HCVOL(.1) = HCDE - HC2(.1)	
000345 000346	60 TO 500	
000347	OOD COUTTAINS	
000347	WRITE (LW+65)	
000349	WRITE(LW.67) VLAP	
000350	WRITE(LW.71) SHUM	
000351	WRITE(LW,73) ROMIX	
000352	WRITE (LW.75) CPMIX	
000353	WRITE(LW.77) CVMIX	
000354	WRITE (LW.79) RMIX	
000355	WRITE(LW.81) XMMIX 201 FORMAT(///2X. INLET CONDITION . 76X	·
	- 0.4	. TELOW NOTTLE CYPANSION FACIORIA

000357	1)
000358	203 FORMATE 2X, DATA 1,5X, INLET TEMPERATURE 1,13X, AMRIENT PRESSURE 1,14
000359	1x. weight Density. 16x. YANOZ!)
000360	205 FORMAT 2X. POINT . 9X. DEG F. 15X. IN HG. 16X. PSIA . 13X, LB/CUFT.
000301	1/)
000362	207 FORMAT (15.F17.3.2F20.3.F20.4.F26.5)
000363	WRITE (LW, 201)
000364	WRITE(LW-83) TORY-TWET-RHUM-PWET
000365	WRITE (LW.203)
000356	WRITE (LW)205)
000367	WRITE (LW,207) (J,T0(J),P0HG(J),P0PS(J),RH0(J),YNN0Z(J),J=1,N0DAT)
000368	
000369	213 FORMATI 2X. TDATA1.7X. TEMPERATURE 1.3X. STAT PRESSURE 1.4X. WEIGHT U
000370	1EHSITY X VOLUMETRIC FLOW RATE 5X . WEIGHT FLOW 5X . BLEED FLOW
000371	2)
000372	215 FORMATE 2X. POINT , 9X. DEG F. 10X. PSIA! 11X, LB/CUFT , 8X, CUFT/S!
000373	1,9X,+GPM+,11X,+LB/S+,11X,+PERCENT+/)
000374	217 FORMAT(15,2F17,3,2F15,4,F15,3,2F15,4)
000375	WRITE (LW, 211)
000376	WRITE(LW, 213)
000377	WRITE(LW.215)
000378	WRITE(LW.215) WRITE(LW.217) (J.TD(J).PSD(J).RHOD(J).VDF(J).VDG(J).VW(J).RVRL(J).
000379	1U=1:NODAT)
000380	221 FORMAT(///2X, INTERSTAGE CONDITION //)
000381	223 FORMAT(2X, DATA 1, 7X, TEMPERATURE 1, 5X, TOT PRESSURE 1, 4X, STAT PRES
อยธ382	ISINE * * 5X * * WEIGHT DENSITY * 9X * * FLOW RAIE*)
.060383	225 FORMAT(2X, POINT', 9X, DEG F', 6X, PSIA (RMK DIA)', 5X, PSIA', 16X, L
000384	1B/CUFT',9X,*CUFT/S',10X,*GPM!/)
000385	227 FORMAT(15,F17.3,2F15.4,F21.4,2F15.3)
000386	WRITE(LW+221)
ს ს ს ს 3 გ 7	WRITE(LW,223)
000388	WRITE (LW, 225)
000389	WRITE(LW.227) (J.TI(J).PTI(J).PSI(J).RHOI(J).VIF(J).VIG(J).J=1.NOD
000390	1AT)
000391	231 FORMAT(///2X, PUMP OVERALL PERFORMANCE!//)
000392	233 FORMAT(2X, DATA: 5X, SPEED: 4X, PRESSURE: 3X, TEMP RISE DEG F: 4X 1, HEAD RISE: 4X, HIS/N**2*,7X, Q/N*,4X, ETA TEMP: 2X, TORQUE T: 3X
006393	1, HEAD RISE 1, 4X, HIS/N**2*, /X, 'Q/N', 4X, 'ETA_LENP', 2X, 'LONGOL', 'VOO
000394	2; NORM TORQUE T') 235 FORMAT(2X; POINT; 5X; RPM; 7X; RATIO; 4X; ACTUAL; 4X; ISENTR; 3X;
000395	1*1SENTR FT: 4X, FT/RPM**21,3X, *GPM/RPM*, 14X, *IN LB*, 5X, *FT**4/RPM*
000396	
000397	2+2*/) 237 FORMAT(15,F12.1,3F10.3,F10.2,E15.4,2F10.4,F10.3,E15.4)
000398	WRITE (LW, 231)
000399	WRITE (LW, 233)
000400	MOTE (III) AZE
600401	WRITE (LW/235) WRITE (LW/237) (J, SN(J), PROV(J), DTAOV(J), DTIOV(J), HISOV(J), HOVN2(J),
000402	ACCULA ACCTOVIAN ATOTOVIAN ATOTOVIAN ATONTO(J) AJE14NODAT)
000403 000404	241 FORMAT (///2X, FFFICIENCY DERIVED FROM MEASURED SHAFT TORQUE AND MO
80640 5	ITOR DOWER: 37Y. PEHEAT FACTOR!//)
000400	243 FORMAT (2X "DATA" 6X "MEASURED TORQUE" 5X "NORM TORQUE" 8X "FFFICE
	1ENCY+,5X, MOTOR POWER+,3X, EFFICIENCY+,17X, RHF+)
00040 7 000408	245 FORMAT (2X, POINT , 8X, IN LB , 11X, FT * * 4/RPM * * 2 , 10X, EFS , 11X, WA
	1TT',10X,'EFMOT',13X,'(HIS1+HIS2)/HISOV'/)
000409	247 FORMAT (15,F17.4,E20.4,3F15.4,F25.5)
000410	WRITE(LW, 241)
000411	
000412	WRITE (LW, 243)
000413	WRITE(LW,245) WRITE(LW,247) (J,TQS(J),TQNS(J),EFS(J),PMOT(J),EFMOT(J),RHF(J),J=1
006414	1,NODAT)
000415	251 FORMAT(///2X,*FIRST STAGE PERFORMANCE*//)

			a proposition and the second and the
000417	253 FORMATE 2X+*DATA*+5X+*PRESSUPE*+2Y+*HEAD PISE*+3X+*HISZD++2*+5X+*Q		
000418	1/0 DELIMINATION TO ANALYSE TA TEMPO, 2X, TEMP FLOW, 3X, PHI(2), 6X, P	the second second second	and the second of the second o
. 000419 000420	2SI*)		•.
000420	255 FORMAT(2X**POINT**,5X**RATIO**,3X**ISENTR FT*,3X**FT/RPM*+2*,4X**GP 2P/RPM**,5X**DEG F*,15X**PERCENT*/)		and a contract of the contract
000422	257 FORMAT(15,F12.4,F10.2,E15.4,F10.4,F10.3,F12.4,F10.3,2F10.4)		
000423	wRITE(Lw, 251)		
000424	write (Lw.253)	The state of the s	Monthodale at the control of the con
) 000425 000426	WRITE (LW-255)		
360427	WRITE(LW:257) (J:PRS1(J):HIS1(J):HNS1(J):OIN(J):DTAS1(J):EFTS1(J): IREC11(J):PH11(J):HC1(J):J=1:MODAT)	er er i i i i i i i i i i i i i i i i i	
J 060428	261 FORMAT(///2x, SECOND STAGE PERFORMANCE*//)		
000429	263 FORMATE 2X; *DATA*; 5X; *PRESSURE*; 2X; *HEAD RISE*; 3X; *HTS/N**2*; 5X; *to		
000430	1/N NET',4X, DELTA T',3X, ETA TEMP',2X, LAR FLOW',3X, PHI(2)',6X, P	The first of the control of the cont	The second section of the second seco
000431	251',3X, 'TOT RECIRC') 265 FORMAT(2X, 'POINT',5X, 'RATIO',3X, 'ISENTP FT',3X, 'FT/RPM**2',4X, 'GP	•	
000433	1M/RPM+5X+'DEG F+.15X+'PERCENT+.23X+'PEPCENT+/)		
+ 000434	267 FORMAT(15,F12.4,F10.2,E15.4,F10.4,F10.3,F12.4,F10.3,3F10.4)	•	
000435	WRITE (LW, 261)		
000436) 000437	witte (rw.563)		
000437	WRITE (LW, 205)		
000439	WRITE(LW,267) (J,PRS2(J),HIS2(J),HNS2(J),ODN(J),DTAS2(J),EFTS2(J), 1RELB2(J),PH12(J),HC2(J),RFC12(J),J=1,NODAT)	The first state of the constraint and the second state of the state of the state of the second state of th	entrophic control of the second of the secon
7 000440	271 FORMAT(///2x.*INDUCER PERFORMANCE*//)		
000441	273 FORMAT(2X, DATA , 3X, NORM STAT HEAD)		
000442 00044 3	275 FORMAT(2X, 'POINT', 2X, 'RISE FT/RPM**2'/) 277 FORMAT(I5, E17.4)	-	
1000444	IF (AF,S (PSIN(1))) 532,532,534		
000445	534 WRITE(LW,271)	e de l'agression de la company de décentage de la company	
000446	WRITE(LW, 273)		
50 100447 50 000448	WRITE (LW-275) .		The second section of the second section is a second section of the second section sec
6 000449	WRITE(LV:277) (J:HSNIN(J):J=1:NODAT) 281 FORMAT(///2X:FIRST STAGE IMPELLER PERFORMANCE BASED ON STATIC WAL		
25 - 000450	1L PRESSURES AND CONTINUITY //)		P.
000451	283 FORMAT (2X, DATA: 4X, MEAN STATIC: 6X, NORM STAT HD: 3X, STAT HEAD	A FROM CONTROL CONTROL CONTROL OF THE CONTROL OF TH	
000452 000453	1',3X,'SLIP',6X,'TOT HEAD',5X,'NORM TOT HD',4X,'PHI(2)',4X,'DENSITY 2 RHO11')		
000455	265 FORMATE 2X, POINT, 3X, PRESSURE PSIA, 2X, RISE FT/RPM**2, 7X, COFF		
000455	1F',15X,'COEFF', 7X,'FT/RPM*#2',18X,'LP/CUET'/)		
000.56	287 FORMAT(15,F17.4,E15.4,F13.4,F10.4,F12.4,F15.4,2F12.4)		
006457 000458	532 WRITE (LW, 201)		
000459	WRITE (LW, 283) WRITE (LW, 285)		
005460	WRITE (LW.287) (J.PSIM1(J).HSMW1(J).HCST1(J).SLPC1(J).HCT11(J).HTNI		
000461	11(J),PHI1(J),RH0I1(J),J=1,N0DAT)		
000452 _ 000463 _	291 FORMAT(///2X, SECOND STAGE IMPELLER PERFORMANCE BASED ON STATIC WA	- Part Control	The second secon
000463	1LL PRESSURES AND CONTINUITY*//) 293 FORMAT(2X,*DATA*,4X,*MEAN STATIC*,6X,*MORM STAT HD*,3X,*STAT HEAD		
000465	1:3X, SLIP: 6X, TOT HEAD: 5X, NORM TOT HO: 4X, PHI(2): 4X, DENSITY		
000466	2 RH012*)		
) 00046 7 . 000468	295 FORMAT(2X, POINT', 3X, PRESSURE PSIA', 2X, RISE FT/RPM**2', 7X, COEF		
000469	1F*,15%,*COEFF*, 7%,*FT/RPM**2*,18%,*L8/CUFT*/) 297 FORMAT(I5,F17.4,E15.4,F13.4,F10.4,F12.4,E15.4,2F12.4)		
0004 70	WRITE (LW, 291)		
000471	WRITE (LW, 293)		
000472 000473	WRITE (LW, 295)	,	3
000473	WRITE(LW:297) (J:PSIM2(J):HSMW2(J):HCSI2(J):SLPC2(J):HCTI2(J):HTNI 12(J):PHI2(J):PHOI2(J):J=1:NODAT)		
000475	301 FORMAT(///2X, *CROSSOVER CHANNEL*//)		
000476	303 FORMAT(2X. DATA . 4X. TOTAL HEAD LOSS CONFFICIENT . 17X. OVERALL .)		
000476	303 FORMAT(2X, DATA . 4X, TOTAL HEAD LOSS CONFFICIENT . 17X, OVERALL .)		See .

		Employee and the second of the second
	The state of the s	and the second s
0004 77 .	305 FORMATI 2X. POINT : 3X. STA 25: 4X. STA 26' 4X. STA 27' 4X. STA 28'	a spirate magning commitment control of the proper property of the control of the
000478	1,8X,*ONC-DIM*/)	•
000479	307 FORMAT(15,F12.4,3F10.4,F14.4) WRITE(LW,301)	
000480 000481	WRITE (LW, 301) WRITE (LW, 303)	ngang anagang ng manahalangan anagandan garantan ana ana na na na na na na marawa. Manahala na manahala na na Tanggan na nagang na
000482	WRITE(1 W. 305)	
000483	WRITE (LW, 307) (J.PCRO1(J).PCRO2(J).PCRO3(J).PCRO4(J).HCCRC(J).J=1.	
. 464000	INOUAT)	
000485	311 FORMAT(///2X.*CIRCUMFERENTIAL PRESSURE DISTRIBUTION - SECOND STAGE 1 INFELLER*//)	· · · · · · · · · · · · · · · · · · ·
000486 00048 7	313 FORMATI 2X, DATA , 3X, NORM AVG , 5X, PATIO OF STATIC HEAD TO AVERAG	And the second s
000468	THE CIATIC UPAN DISCIPA	
000489	315 FORMAT(2X, POINT, 2X, STATIC HEAD!, 2X, (1) 1, 7X, (2) 1, 7X, (3) 1, 7X,	And the second s
000490	1 * (4) * + 7 X , * (5) * + 7 X , * (6) * + 7 X , * (7) * + 7 X , * (8) * + 7 X , * (9) * /)	
00049 1 000492	317 FORMAY(15,E15.4,9F10.6) WRITE(LW,311)	
000492	WRITE(LW, 313)	•
000424	100777 (1 to . 310)	
000495	- WRITE (LW,317) (J.HSIM2(J).HS201(J).HS202(J).HS203(J).HS204(J).HS20	AND THE PROPERTY OF THE PROPER
000496	15(U),H5206(U),H5207(J),H5208(U),H5209(U),J=1,NODAT) 16(BCP12-9) 400,400,402	
00649 7 666498	402 CONTINUE	
000473	319 FORMAT(//2X. DATA . 4X. TRATIO OF STATIC HEAD RISE TO AVERAGE STATIC	
000500	1 HEAD RICE()	
000501	321 FORMAT(2X, 'POINT', 8X, '(10)', 8X, '(11)', 8X, '(12)', 8X, '(13)', 8X, '(14	The second secon
000102	1)''8X''(15)''8X''(16)''8X''(17)''8X''(18)'') 323 FORMAT(15)F15.6'8F11.6)	
00050 3 000504	323 FORMATCIBER 13-678-11-67 WRITE (LW-319)	
000504	WRITE (LW-321)	
000506	WRITE (LW, 323) (J. HS210(J) + HS211(J) + HS212(J) + HS213(J) + HS214(J) + HS21	
000507	15(J), HS216(J), HS217(J), HS218(J), J=1, NODAT)	
000000	400 IF(ROPI2-3) 404,404,401 401 WRITE(LW,441)	
000509 000510	WRITE (LW, 443)	
600511	PRITE (LV-045) (J-PAFK(J)-THETR(J)-J=1-NODAT)	
000512	441 FORMAT(///2X, *RADIAL FORCE PARAMETER RAFK AND FORCE VECTOR ANGLE T THETA MEASURED COUNTER-CLOCKWISE WHEN LOOKING FROM SUCTION / 30X.	•
000513	2. THETA MEASURED COUNTER-CLOCKWISE WHEN LOOKING FROM SUCTION / SUA.	
000514 000515	443 FORMAT(2X, *DATA*, 8X, *RAFK*, 13X, *THETA*/2X, *POINT*, 7X, *I*)**2*, 14X,	
000516	1.DEG.*/)	and the state of t
200517	445 FORMAT(15,F15.6,F16.2)	
000518	404 CONTINUE	•
000519	331 FORMAT(///2X, DIFFUSION HOUSING - SECOND STAGE!//) 333 FORMAT(2X, DATA:, 3X, NORM DIFF DISCH MEAN!, 2X, HEAD LOSS COFF!, 3	and the contract of the contra
000520 000521	1V. HEAD LOSS COEFEL.2X. HEAD LOSS COFFEL)	•
000122	335 FORMATI 2X, POINT , DX, STAT HD FT/RPM**2, 4X, HOUSE ONE-DIM , 3X,	and the second s
ยงบ523	1.DIEF ONE DIM: 4X: VOLUTE ONE-DIM:/)	
000524	337 FORMAT(15,E20.4,3F16.4)	
000525	WRITE(LW, 331) WRITE(LW, 333)	administratives in the state of
000526	WRITE (LW, 335)	
000528	WRITE(LW, 337) (J. HSDFM(J), HCDHC(J), HCDFC(J), HCVOL(J), J=1, NODAT)	
000529	60 10 520	
000530	990 WRITE(LW,3)	
000531	STOP END	
006532	LINO	•

```
W ELT RATHR. 1.720405. 49930
                       SUBROUTINE RATHR
000001
                      DIMENSION
0000032
                      COMMON J. THET (18) , PSI (18) , B2TH DI21 , DI21 , DI22 , NOPI , NST , RAFK (30) ,
360003
                      ITHETR(30), DTHET(18) . FFMOT(30), PMOT(30), PSIM2(30), POPS(30)
0000004
                      IF(NST-1) 80,80.90
000005
                    80 DI2 = DI21
0000065
                       60 TO 95
000007
                    90 \text{ DI2} = \text{DI22}
800066
                    95 SKY = 6 ____
060669
                       5KX = 0
500010
                       STHET = 0
000011
                       DO 102 I=1:NOPI
060012
                       STHET = STHET + DTHET(1)
000013
                       PSIS(I) = PSI(I) * SIN(THET(I)) *DI2*R2TH*SIN(DTHET(I)/2.)
000014
                       PSIC(1) = PSI(1) * COS(THET(1)) *DI2*82TH*SIN(DTHET(1)/2.)
000015
                       SKY = SKY + PSIS(I)
000016
                   102 SKX = SKX + PSIC(I)
000017
                       SKY = -SKY
000018
                       SKX = -SKX
000019
                                              50RT(SKY**2+SKX**2)
                       RAFK(J) =
000020
                       TTHET = ATAM(ABS(SKY/SKX))
000621
                       IF(SKY) 110,150,115
060022
                   115 IF (SKX) 120,155,125
000023
                   125 THETR(J) = 57.296 * TTHET
000024
                       GO TO 200
000025
                   155 THETR(J) = 90.
ujuu26
                       60 TO 200
000027
                   120 THETR(J) = (3.1417 - TTHET) * 57.296
000028
                       GO TO 200
000629
                   110 IF (SKX) 130,170,135
000030
                   130 THEIR(J) = 57.296 * (TTHET + 3.1417)
506031
                       GO TO 200
000032
                    170 THETR(J) = 270.
000633
                       GO TO 200
000034
                    135 THETR(J) = (6.2834 - TTHET) * 57.296
000035
                       60 TO 200
000036
                    150 IF (SKX) 140,160,145
000037
                    140 THETR(J) = 180.
 000038
                       GO TO 200
 600039
                    160 THETR(J) = 0
 000040
                       60 TO 200
 000041
                    145 THETR(J) = 0
 000042
                    200 RETURN
 000043
                       END
 000044
                                                                                                 13:52:21
       END CUR
```

.

	ند مُعَلِّمُ مِنْ اللَّهِ مِنْ ا	and the second second second second second		<u> </u>	Mark 1978 And Alberta State Control
					······()·····
DATE 89-72-/1	NERVA			•	The Carlotte Control of the Ca
	RD3839	MANCE DATA			
	TEST	NO. 69	anness per mer de tras propos une la leviente del destante de l'Adrian de		
		g die same site diegen spisspiller in segeng is a grow dienen den samte befolklich werste die			
CONSTANTS		٠.			
COZZLE COSFFICIENT, CNOZ COZZLE CIA, DNOZ COZZLE CIA, DNOZ COZZLE CIA, DNOZ COZZLE COSFFICIENT			•	•	
ISCHARGE LINE DIA, DDL					•
MAG TORQUE, TUBRU	· ·		ercoup STACE		
EISCHARGE AREA BLOCKED, AIZI ISCHARGE DIAPPTER, DIIZ ABYRINTH COEFFICIENT, CLABI	14.800 SOIN 10.950 IN	DISCHARGE AREA BU	OCKED, AI22 R, DI22	15.700 SOIN 19.750 IN	
ABYRINTH COEFFICIENT, CLABI		LABYRINTH COFFFIC NUMBER OF BLADES, DISCHARGE BLADE A	Z22 NGLE, BET22	3.0 0 4+ 25.000 DEG	
ABYRINTH FLOW AREA, ALBI NOUCER INLET TIP DIA, DILLT NOUCER INLET HUB DIA, DILLH		AA HORINTH FLOA AF INLET TIP DIAMETE INLET HUB DIAMETE	R, DIZIT R, DIZIH	6.343 IN 6.343 IN 4.630 IN	routeningerings is any special file. After 1880 - 1886-1886 file fi
The state of the s		WIDTH, RADIAL TRE	ust, azth	1.300-1N-	
	ноиз			•	· '
ROSSOVER AREA, ACROS ROSSOVER AREA, ACROS DIFFUSER DISCHARGE AREA, ADFD	4,002 SQIN 6.900 SQIN	CROSSOVER AREA, A	CRO2 CRO4	5.400 SGIN 8.100 SGIN 14.300 DEG	
DIFFUSER DISCHARGE AREAS AUFU	20 a 0 E 0 5 0 1 M	DIFF. CIGCHENGE.	.07. NICOCC 9 001 0-		
CALCULATED CONSTANTS			er green hannes opprove and company administration and all and the		
VELOCITY OF APPROACH FACTOR, FLO	W NOZZLE, VLAP	1.0205 **	Tangan () or many samples of the samples of the grants of the samples of the sample of the samples of the sample of the samples of the sampl	*	reproductive to the state sentency trappolation and traditions of
KSSOLUT HUHIDITY, AHUH				make says of the same of the s	
MIXTURE DENSITY, ROMIX SPECIFIC MEAT CP SPECIFIC MEAT CV		.0723 LB/FT** .2499 BTU/LB/ 1727 BTU/LB/) F.G.		والمعاودة
SPECIFIC MEAT CV GLS CONSTANT, RHIX MOLECULAR WEIGHT, WMOL	,	53,05%7 FTLB/LB	/DEG	·	
			and the second s		
INTEL CONDILION	and the second s			PLOW NOZZLE EXPANSION	N FACTOR
TURY * 85.00 . THET # 67	.00 REL HUMIDITY B	37PWET . 9	667 INHG		
•,		WEIGHT	A # 14 0 = T 14	W. 1. 1. 19. 19	•

	•							()
+	79.708		14.0	51	.9730	9735	າ	
2	79,838	22.852	- ·		.2738	.9798		
$\tilde{3}$	79,878	29.352			.0738			• •
4						2387		
5	R0.100	29,650		•	.2737	, 9929		
<u> </u>	80.470	20,450	14,4		.0737	,9946		
/ u-	សស.50ព សស.50ព		14.6	· ·		. 9958 a 9979		
ů	80,600	27.958 29.858			\$7737 \$7737	.9993		
,								· · · · · · · · · · · · · · · · · · ·
				• •				•
UPP DIS	CHARGE CONDITIO	N						
. • .	********	A	UELAUT BEUGTEU	uni llucante et	والمراز	AUT BLOO HIEF	n #1.69	•
ATA GINT	TEMPERATURE DEG F	STAT PRESSURE PSIA	LB/CUFT	. VOCUMETRIC-PI - CUFT/3		GHT.FLOWBLEE L8/8 PE	RCENT	
-			4. 4					•
! .								
2	97,700	15.799	.8769	6.28/6	2820.710	,4835	4.3846	
3	94.342	18.996	.0782	5,5271	2480.724	. 4323	5,4857	
4							7.0733	
.5.	102.030	16.569	1989.	3.8709	1740.964	.3106	8.4186	*
6	183.000	16.677	. 4475 	5.4384	1543.286		18.1952 11.4441	
/	. 104.550 L 125.650		.0318	2.2717	1020.249		15,7072	
ò	106,202	15.869	6989	1.5703	705.693		22,7313	
·								
							•	• •
		•				<i>:</i>		
NTERSTAI	MOITICHOS 20				* . 			
					אַרוִשִּ	PATE	•	
ΔŤΑ		TOT PRESSURE.	3TAT PRESSURE		TTYFLOK	_RATEGPM		
ል ^ተ ል	TEMPERATURE	TOT PRESSURE PSIA (RMR DIA)	3TAT.PRESSURE	WEIGHT DENS	CUFT/S	GPM		
a T A	TEMPERATURE_ DEG F A8.350	TOT PRESSURE PSIA (RMR DIA)	3TAT PRESSURE PSIA 15.6981	WEIGHT DENS	CUFT/S 7.415	GPM 3328.155		
ATA DINT 1	TEMPERATURE DEG F A8.350 88.700	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446	3"AT PRESSURE PSIA 15.6981	WEIGHT DENS LB/CUFT	7.415 6.680	GPM 3328.155 2998.350		
a T A	TEMPERATURE_ DEG F A8.350 A8.700 P9.300	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446	37AT .PRESSURE PSIA 15.6981 15.2644 15.4053	WEIGHT DENS LB/CUFT .0748 .0755 .0752	7.415 6.680 5.987	GPM 3328.155 2998.350 2687.072		
ETA DINT 1	TEMPERATURE DEG	TOT PRESSURE . PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.5644	37AT.PRESSURE PSIA 15.6981 15.2644 15.4063 15.5426	WEIGHT DENS LE/CUST 	7.415 6.680 5.987	GPM 3328.155 2998.350		
ETA DINT 1	TEMPERATURE_ DEG F A8.350 A8.700 P9.300	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446	37AT .PRESSURE PSIA 15.6981 15.2644 15.4053	WEIGHT DENS LE/CUST 	CUFT/S 7.415 6.688 5.987 5.135	GPM 3328.155 2998.350 2697.072 2304.631		
ATA DINT 1	TEMPERATURE_ DEG F A8.35A 88.700 00.300 90.300 91.700	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.444 15.6596	3TAT PRESSURE	#EIGHT_DENS LEZCUFT 	7.415 6.689 5.987 5.135 4.367	GPM 3328.155 2998.350 2687.072 2304.031 1968.007		
ETA DINT 1	TEMPERATURE_ DEG F A8.35A 88.700 00.300 90.300 91.700	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.6644 15.6596 15.7773	3TAT PRESSURE	MEIGHT DENS LE/CUFT .0748 .0755 .0762 .0767 .4771 .2773 .0773 .0776	CUFT/S 7.415 6.680 5.907 5.135 4.367 3.945 3.555 2.747	GPM 2998.350 2697.972 2384.631 1968.887 1772.819 1595.622 1233.159		
ETA DINT L	TEMPERATURE_ DEG F A8.350 88.700 89.300 90.202 91.700 92.500	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.4346 15.6544 15.6596 15.7273	3TAT .PRESSURE PSIA 15.0981 15.2544 15.4053 15.5426 15.6438 15.6944 15.7270	MEIGHT DENS LE/CUFT .0748 .0755 .0762 .0767 .2771 .2773	CUFT/S 7.415 6.689 5.987 5.135 4.367 3.945	GPM 2998.350 2998.350 2697.072 2334.031 1960.007 1778.819 1595.622		
ATA DINT . t . 2 . 3 . 4 	TEMPERATURE DEG F A8.350 88.700 89.390 99.202 91.700 92.500 93.100	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.4346 15.5644 15.6596 15.7273 15.7374 15.8319	3TAT.PRESSURE PSIA	MEIGHT DENS LE/CUFT .0748 .0755 .0762 .0767 .4771 .2773 .0773 .0776	CUFT/S 7.415 6.680 5.907 5.135 4.367 3.945 3.555 2.747	GPM 2998.350 2697.972 2384.631 1968.887 1772.819 1595.622 1233.159		
2TA 2INT 12 3 4 5 6 7	TEMPERATURE DEG F A8.35A 88.700 90.300 90.202 91.700 91.700 92.504 93.100 93.404	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.6596 15.7273 15.7374 15.8017 15.8315	3TAT.PRESSURE PSIA	MEIGHT DENS LE/CUFT .0748 .0755 .0762 .0767 .4771 .2773 .0773 .0776	CUFT/S 7.415 6.680 5.907 5.135 4.367 3.945 3.555 2.747	GPM 2998.350 2697.972 2384.631 1968.887 1772.819 1595.622 1233.159		
ATA OINT 1 2 3 4 5 6 7	TEMPERATURE DEG F A8.350 88.700 89.390 99.202 91.700 92.500 93.100	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.6596 15.7273 15.7374 15.8017 15.8315	3TAT.PRESSURE PSIA	MEIGHT DENS LE/CUFT .0748 .0755 .0762 .0767 .4771 .2773 .0773 .0776	CUFT/S 7.415 6.680 5.907 5.135 4.367 3.945 3.555 2.747	GPM 2998.350 2697.972 2384.631 1968.887 1772.819 1595.622 1233.159		
ATA OINT 1 2 3 4 5 6 7	TEMPERATURE DEG F A8.350 A8.350 A8.700 A9.300 A9.202 A1.700 A1.700 A2.500 A3.100 A400 RALL PERFORMANC	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.4346 15.6596 15.7273 15.7374 15.8319 15.9315	3TAT.PRESSURE PSIA	#EIGHT_DENS LE/CUFT .0748 .0755 .0762 .0767 .0771 .2773 .0773 .0776 .0777	CUFT/S 7.415 6.688 5.987 5.135 4.367 3.945 3.555 2.747 2.010	GPM 3328.155 2998.350 2697.072 2304.631 1968.007 1772.819 1595.622 1233.159 902.181	IORM_TORQUE_T.	
ATA ATA	TEMPERATURE DEG F A8.350 A8.350 A8.700 A9.300 A9.202 A1.700 A1.700 A2.500 A3.100 A400 RALL PERFORMANC	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.6596 15.7273 15.7374 15.0019 15.8515	, 3"AT PRESSURE PSIA 15.6981 15.2644 15.4063 15.5426 15.6438 15.6944 15.7270 15.7956 15.8262	#EIGHT_DENS LE/CUFT .0748 .0755 .0762 .0767 .0771 .2773 .0773 .0776 .0777	CUFT/S 7.415 6.689 5.987 5.135 4.367 3.945 3.555 2.747 2.010	GPM 3328.155 2998.350 2697.072 2304.031 1968.007 1770.819 1595.622 1233.159 902.181	ORM_TORQUE_T T**4/RPM**2	
ATA OINT 2 3 4 5 6 7 8 9	TEMPERATURE DEG F A8.350 A8.700 A9.300 A9.300 A9.202 A1.700 A2.100 A3.100 A3.400 RALL PERFORMANC SPEED PRESS RAT	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.4346 15.6596 15.7273 15.7374 15.8319 15.9315	## STAT PRESSURE ## PSTA ## 15.6981 ## 15.2644 ## 15.4965 ## 15.6944 ## 15.7270 ## 15.7956 ## 15.8262 ## ESENTR ## EAD RISESENTR ISENTR FT	MEIGHT DENS LE/CUST .0748 .0755 .0762 .0767 .0771 .0773 .0773 .0773 .0777 .0777	CUFT/S 7.415 6.680 5.987 5.135 4.367 3.945 3.555 2.747 2.010	GPM 3328.155 2998.350 2697.072 2304.031 1960.007 1776.819 1595.622 1233.159 902.181 EMPTORQUE_TN IN_L8 F		
ATA OINT 1 2 3 4 5 6 7 7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	TEMPERATURE	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3446 15.6444 15.6596 15.7273 15.7374 15.8919 15.9515 EURE TEMP RISE D ACTUAL I	### ### ##############################	#EIGHT_DENS LE/CUFT .0748 .0756 .0762 .0767 .0771 .0773 .0773 .0777 .0777 .0777	CUFT/S 7.415 6.689 5.987 5.135 4.367 3.945 3.555 2.747 2.010 Q/N ETA-7 GPM/RPM 4567. 47	GPM 3328.155 2998.350 2697.072 2304.031 1960.007 1776.819 1595.622 1233.159 902.181 EMPTORQUE_TNN L8 F	T**4/RPM**2	
ATA OINT 12 33 4 56 7 8 9 UMP.GVE	TEMPERATURE DEG F A8.350 A8.700 A9.300 A9.300 A9.202 A1.700 A2.100 A3.100 A3.400 RALL PERFORMANC SPEED PRESS RAT	TOT PRESSURE PSIA (RMR DIA) 15.1422 15.3006 15.4346 15.6596 15.7273 15.7374 15.0019 15.9315	## STAT PRESSURE ## PSTA ## 15.6981 ## 15.2644 ## 15.4965 ## 15.6944 ## 15.7270 ## 15.7956 ## 15.8262 ## ESENTR ## EAD RISESENTR ISENTR FT	MEIGHT DENS LE/CUST .0748 .0755 .0762 .0767 .0771 .0773 .0773 .0773 .0777 .0777	CUFT/S 7.415 6.688 5.987 5.135 4.367 3.945 3.555 2.747 2.010 Q/N ETA-7 GPM/RPM 4567 4030 644 3543	GPM 3328.155 2998.350 2697.072 2304.031 1960.007 1772.819 1595.622 1233.159 902.181 EMPTORQUE_TN IN_L8 F 12	.6549+06 .6549+06 .6800+06 .5656+06	

A Miles of the Control	in the same of		Tera systematical desired										
											anganasiana, i a ing namang dining	برای ^{دهما} م	
- · · · -	· · · · · · · · · · · · · · · · · · ·		-	;··-	• •		()						
6	75.3.0	1.138	22.600	28,127	3773,0	и1 .	2593-04	.2284	.8474	20.154	4257-25		
7	- 7421.3 -	1.143	24.000	20.769	_3893.7	32	.7943=04	1962	0155	17,200	4051+06		
8	7305.0	1,150	25.000	21,843	4934,6	69	0345-64	4 3.457	.0101	10.4225	3194#06 _2325 = 06		
S	7013.0	1.151	25.698	21.376	4104.0	65	_85345=04	.1006	.7689	11.110			
									•				
FFICIS	NCY DERIVED	FROM HEAT	SURED SHAFT	TORPUE	ND MOT	OR POWER				REHEA	T FACTOR		
						٠.							
474	MEASURED	TORQUE	- NORM TORD	UE	EFF I	CIENCY	HOTOR PONE	R EFFIC	ENCY	41.704.	AHF		
DINT	IN LB		FT++4/RPM+	*2	EF.	s ·	MATT	EFM01	ſ	(HISI+	HIS2)/HISOV		
			\						40		1.00273		
. !	27.80				, 49	• '		.089.			1.03109		
2	27,58		.6078~0		, 53	94	ୁମନ୍ପ୍ର ୁମନ୍ପ୍ର	. 20			1.22133		
3	27.20		.5711mB		71						1.00084		
4	23,60 23,60		.5612#0		.77		. WAGO	.30:			1.82053		
C g	22,38		4718-2		.76		្តិក្រុង		ুল		1.00056		
	21.38		4495-9		73		gess		va		1.80/191		
ė	19.68		3985-6		.64	93	. 6040	• ପ୍ର			1.00078		•
9	15.60		₂ 3257≖8		,54	73	• ପ୍ରଦ୍ୟର	. ପଥ	8 9		1.00077		
•	TAGE PERFOR	•				- 		and distance to the second	***************************************				· = w=
- , ATA	_ PRESSURE_	•			N NET.	DELTA-	TETA TEMP.	LAB FLOW PERCENT	PHI(2)	PSI -			
ATA DINT	_ PRESSURE_ RATIO	HEAD RISE ISENTR FT	FT/RPH++2	P GPM/	ZRPM.	DEG F		PERCENT		,2570			
ATA	PRESSURE_ RATIO 1.0329	HEAD RIST ISENTE FT	FT/RPH++2 	P GPM	ZRPM.	DEG F	TETA TEMP-	1.731 - 1.907					
ATA DINT	- PRESSURE- RATIO 1.0329 1.0436	MEAD RISE ISENTE FT 928.74 1229.73	FT/RPH++2	9 GPM/	/RPM. 4599	DEG F 0,650		1.731 - 1.907 2.113		.3532 .4256	· · · · · · · · · · · · · · · · · · ·		
ATA	PRESSURE_ RATIO 1.0329 1.0436 1.0528	HEAD RIST ISENTE FT	FT/RPM++2 	GPM/	/RPM 4599 4103 3638 3075	DEG F 0,650 8,990 9,500 10,209		1.731 - 1.907 2.110 2.500 -		.2670 .3532 .4256 .4960	· · · · · · · · · · · · · · · · · · ·	•	
ATA	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0516 1.2681	928.74 1229.73 1482.75 1726.76	FT/RPM++2 	GPMA	/RPM 4599 4103 3638 3075 2583	DEG F 0,650 8,990 9,500 10,209 16,909		1.731 - 1.907 2.110 		.2670 .3532 .4256 .4960 .5471	· · · · · · · · · · · · · · · · · · ·		
ATA	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.2681 1.2714	HEAD RISE ISENTR FT 928.74 1229.73 1462.75 1726.76 1934.95 1994.87	FT/RPM**2	GPM/	/RPM 4599 4103 3638 3075 2583 2295	DEG F 8,650 8,940 9,500 10,209 10,209 11,309		1.731 1.907 2.110 2.500 2.974 3.359		.2670 .3532 .4256 .4960 .5471 .5724			
ATA	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.3661 1.0714 1.0714	928.74 1229.73 1482.75 1726.76 1934.87 2051.28	FT/RPM++2	GPM/	ZRPM 4599 4103 3638 3975 2583 2295 2845	DEG F 0.650 8.900 9.500 10.200 10.200 11.300 12.000	.5728	1.731 1.907 2.117 		.2670 .3532 .4256 .4960 .5471 .5724			
ATA DINT	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.2681 1.2714	HEAD RISE ISENTR FT 928.74 1229.73 1462.75 1726.76 1934.95 1994.87	FT/RPM**2	GPMA 74 74 74 74 74	/RPM 4599 4103 3638 3075 2583 2295	DEG F 8,650 8,940 9,500 10,209 10,209 11,309		1.731 1.907 2.110 2.500 2.974 3.359		2670 3532 4256 4960 5471 5724 5959			
ATA DINT 1 2 3 4 5 6	- PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.2681 1.0714 1.0778	928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.20	FT/RPM++2	GPMA 74 74 74 74 74	/RPM 4599 4103 3638 3075 2583 2295 2045	DEG F		1.731 - 1.907 2.110 		2670 3532 4256 4960 5471 5724 5959			
ATA OINT 1 2 3 4 5 6 7 8 9	- PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.0714 1.0714 1.0778 1.0778	PEAD RISI ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.20 2171.19 2226.32	FT/RPM++2	GPMA 74 74 74 74 74	/RPM 4599 4103 3638 3075 2583 2295 2045	DEG F		1.731 - 1.907 2.110 		2670 3532 4256 4960 5471 5724 5959			
ATA OINT 12 3	- PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.2681 1.0714 1.0778	PEAD RISI ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.20 2171.19 2226.32	FT/RPM++2	GPMA 74 74 74 74 74	/RPM 4599 4103 3638 3075 2583 2295 2045	DEG F		1.731 - 1.907 2.110 		2670 3532 4256 4960 5471 5724 5959			
ATA	- PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.0714 1.0714 1.0778 1.0778	PEAD RISI ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.87 2051.20 2171.19 2226.02	FT/RPM++2	GPM/ 24	ZRPM 4599 4103 3638 3975 2295 2945 1521 1946	DEG F		1.731 - 1.907 - 2.117 - 2.507 - 2.974 - 3.359 - 3.768 - 5.232 - 7.366					
ATAOINT 12 34 5678	- PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.0714 1.0714 1.0778 1.0778	HEAD RISI ISENTR FT 928.74 1229.73 1482.75 1726.76 1994.87 2051.20 2171.19 2226.82 ORMANCE	FT/RPM++2	GPM	ZRPM 4599 4103 3638 3975 2295 2945 1521 1946	DEG F		1.731 - 1.907 - 2.110 - 2.500 - 2.974 - 3.359 - 3.768 - 5.032 - 7.335	.2072 .1064 .1665 .1419 .1247 .1071 .0059 .9722 .0598				
ATAOINT 12 34 567		MEAD RIST ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.29 2171.19 2226.02 ORMANCE HEAD RIST ISENTR FT	FT/RPM++2	GPM	XRPM 4599	DEG F 0.650 8.990 9.500 10.200 10.200 11.300 12.500 12.500 12.500	.5728 .7371 .8326 .9831 .9323 .9417 .9119 .9266 .9277	1.731 - 1.907 - 2.110 - 2.500 - 2.974 - 3.359 - 3.768 - 5.032 - 7.335	.2072 .1064 .1065 .1419 .1271 .0059 .9722 .0508		TOT RECIRC PERCENT		
ATAOINT 12 34 5678		MEAD RIST ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.29 2171.19 2226.02 ORMANCE HEAD RIST ISENTR FT	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	78PM 4599 4103 3638 3075 2563 2295 2295 2295 2295 22945 1521 1346	DEG F	.5728	1.731 1.907 2.117 2.507 2.507 3.359 3.768 5.732 7.366	.2072 .1064 .1665 .1419 .1297 .1071 .2059 .9722 .0588				
ATA OINT 12 3 .45 678	PRESSURE RATIO 1.0329 1.0436 1.0528 1.0616 1.0714 1.0774 1.0778 1.0779 STAGE PERFO	MEAD RIST ISENTR FT 928.74 1229.73 1482.75 1726.76 1934.95 1994.87 2051.29 2171.19 2226.02 ORMANCE HEAD RIST ISENTR FT	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	78PM 4599	DEG F 0.650 8.990 9.500 10.209 11.309 12.500 12.500 2.500	.5728	1.731 1.907 2.117 2.507 2.507 3.359 3.768 5.732 7.366	.2072 .1064 .1665 .1419 .1297 .1071 .9059 .9722 .0598				
ATA		HEAD RIST ISENTR FT 920.74	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	78PM 4599	DEG F 0.650 8.990 9.500 10.209 10.309 12.500 12.500 2.500	.5728	1.731 1.907 2.117 2.500 2.974 3.359 3.768 5.032 7.336	.2072 .1064 .1665 .1419 .1297 .1071 .9059 .9722 .0598 .1056 .1422	2670 3532 4256 4960 5471 5724 5999 6226 6359 PSI 1879 2915 3753	TOT RECIRC PERCENT 4.8189 6.0410 7.4407 9.5356		
ATA	PRESSURE - RATIO 1.0329 1.0436 1.0528 1.0681 1.0714 1.0778 1.0778 1.0779 STAGE PERFO PRESSURE RATIO 1.0218 1.0348 1.0440	HEAD RIST ISENTR FT 928.74	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	XRPM 4599 4103 3638 3075 2295 22945 2295 22945 45 45 45 45 45 46 46 46 46 46 46 46 46 46 46 46 46 46	DEG F 0.652		1.731- 1.907 2.117 2.500- 2.974 3.359 3.768 5.232 7.336	.2072 .1064 .1065 .1419 .1277 .1071 .0059 .0722 .0508 .1646 .1656 .1422	2670 3532 4236 4236 5471 5724 5899 6226 6369 PSI 1879 2915 3753 4488 5988	TOT RECIRC PERCENT 4.8189 6.0410 7.4407 9.5356 11.4817		
ATA	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0616 1.2681 1.0714 1.0778 1.0779 STAGE PERFO PRESSURE RATIO 1.0348 1.0348 1.0348 1.0586 1.0586 1.0586	MEAD RIST ISENTR FT 928.74 1229.73 1482.75 1704.95 1904.87 2051.20 2171.19 2226.02 ORMANCE HEAD RIST ISENTR FT 629.86 978.39 1260.34 1575.65 1758.05	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	XRPM 4599	DEG F 0.650		1.731 1.907 2.117 2.507 2.507 3.359 3.768 5.032 7.386	.2072 .1064 .1665 .1217 .1071 .0059 .0722 .0588 .1656 .1486 .1656				
ATA	PRESSURE- RATIO 1.0329 1.0436 1.0528 1.0681 1.0714 1.0778 1.0778 1.0779 STAGE PERFO PRESSURE RATIO 1.0340 1.0340 1.0586 1.0586 1.0586 1.0586	MEAD RIST ISENTR FT 920.74 1229.73 1482.75 1726.76 1934.95 1994.87 2451.19 2226.32 ORMANCE HEAD RIST 629.86 976.39 1267.34 1575.65 1678.85	FT/RPM++2	GPM 74 74 74 74 74 74 74 74 74 7	XRPM 4599 4103 3638 3075 2085 2085 1521 1046 -	DEG F 0.652		1.731- 1.907 2.117 2.500- 2.974 3.359 3.768 5.232 7.336	.2072 .1064 .1065 .1419 .1277 .1071 .0059 .0722 .0508 .1646 .1656 .1422				

	•							VER CHANNEL	" C RO2 20 .
				• .	•		· .		
	Z080*	9490*	4521404	1099*	Z019*	4240	40-576S.	5059*91	6
•	3 u e u .	\$770.	4336-34	.6267	ស សេខ •	4275	.2928-NA	6685.91	8
		zeou •	A9-8908.	SEAR	- \$28X.	9 X O V •	. 2791-0A	7284.01	2 9
	1969.	2631	. 3829-84	0699	0287,	*204S	₽₩∃₩₹ ₹\$*	1664.41 0645.41	ç
	8678	1212	70-5595	2204				1781.81	 ;
· · · · · · · · · · · · · · · · · · ·	8620	SSAI	2263-64	6612.	7426	EIRE.	\$6407£0.	8779,21	έ
	5875	9991	*5846+64 *2524-64	8885. 881	1827,	.2682	1837-61	18,7792	Š
	9775	SU22		6212			po-0251*	15,5483	
•	79Z0	3700	711 2210				•		
•	FB\cnE1	•	FT/K9M##2	COEFF		9 3 3 9 3 9	RISE FT/RPM++2	PRESSURE PSIA	THIO
	DENBILL BHOIS-	(Z) IHa	OH : TOT MHON	0 V 3 H 1 C I	3L1P.	GABH .TATS-	CH TATE MADN	DITATE MASH	ATAC
	•							,	
	·			LUAN AUGUSTON		น…คราชเด.พก=	PERFORMANCE BASED	STAGE IMPELLER:	ECOND
	•.		ALTHNI.	THOS AND CONT	120200 1111	M DIIIIG NO	43810 30474600420		_ ,
						•			
• • • • • • • • • • • • • • • • • • • •	£ Z Z G * .	8 ଓ ଦିଷ ଜ	*25.20*0¢	*\222	Z287.	9867	*324S+64	9149*91	Ö
	3220	6722	* \$2 * 869 \$. \$24A.	9922*	ENTA	13371-0A	15,5246	8
	89/3.	6960	4532464 ·	\$5£9.	9791		AN-0815	1505,61	·
•	8928*	1281	₽8-1987°	1519.	688%	4316	h8-\388.	1900'51	9
	492 0°	* (530	DU-DEID.	6285	\$ 1897	irir"	, 2943-84	12,4125	<u> </u>
	59/8	6171	3828+84	90ES	7397	\7 \8 \&	27748-84	12,3519	. ξ
	£923* ·	9991.	23483-84	4962	1227	*259V6	*252244444 *253244444	6676°G1	Ş.
	1948	p981.	23-6816	* 4462	8637	\$292	NO-7795	\$881.81	
	6279,	\$105		48nh	2703	3.000	10-2200	9001 31	•
			FIVEPRAM	COEFF		COEFF	RISE FT/RPN++2	PHESSURE PSIA	INIO
······································		(2)784	- 0H TOT M90M-	CA3H TOT-	aras .	GA3H TATE.	OH. TATE MAON	HEAN STATIC	V 1.7
•	Jiona Vilousa	1075110					•		
				TES. AND CONTI	เกา พหยออกเ	AM SITATE MO	ERFORMANCE BASED.	IQ. RBJJJBGHI BOAT	R TRAT
								,	
					•			\$5582402	5
	•	•		•				50 - 747.	ß
	· · · · · · · · · · · · · · · · · · ·							าารถ⇔8ๆหรู้ า	L
				•		•		30-0274	9
•		•			•		· · · · · · · · · · · · · · · · · · ·	SUM TUTE	94
;			un ca cadamatana san sana sadamene s					- SEMIZEL	ř
	• .			•	•		•	Z0-8962.**	7
		·						en=e8xe.=	:
							•	30.3013	•
							•	:12E FT/RPH++2	1410
								MORH SINI HEAD	
					•		•	GIBN TITO NOO	• •
		nas anna ar uga ar tupitania dia status dia ma	a a a annual e page an an annual especies (mayor regionals hi	-	•		•	ЗЭм∀икОзы∃а	

2 2000						•					` `		
			• • • • • • • • • • • • • • • • • • • •	•	()	•		•		'	('\ \ }√ [±]		
3 0.000	 0000 . ⋅.	0000	0000	1354						· · · · · · · · · · · · · · · · · · ·			
	.0000	.0000	•0000	.0951 .0647									
3 .0000	•0000	.0000	•0000 •0000	0936.		,							
4	0000		0000	•0375									
5 .0000	•0000	•0000 •0000	• 00.90	•040A									
6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 ·	.0000		• 9000										
7		00000	•0000	.0665									
a .nun	.0000	• angn • angn	•0000	.0001						•	•		
9 .Juuli	•00ai)												
							•					•	
CIRCUMFERENTIAL PR	ESSURE DIS	TRIBUTION. =	SECOND. ST	NGELIMPELL	ER								
				,									
DATA HORY AVG		STATIC HEA	D TO AVERA	GE STATICAL (4)	HEAD RISE	(6)	(7)	(8)	(9)				
POINT STATIC MEAL	111	(2)		·									
1 •3475-04	985765	. •993774		993774 _	_1.005783_	_1.009784_	_1.005783.	.1.009784	1.001783_				
2 . 4246-04			.995441		1.901759	1.004909	1.004909						
-3, .50A8-04	. 991109	• 996445	• 096445	.999112	•000118	1.004444	1.004444	1.007111					
45374-04				209238_	_1.001525	_1.C03815.	_1.003n15	1 • 005102.	_1.0U1526_				_
5 46472-08	•991523		•997710	•000771	1.001833	1.003894	1.003894	1.003899	C.C.0.1.00		٠.		
6 .0/0d=04			• 506546	•000010	1.000873	1.004799	1.004799		1.000873				
7 6976~05	993020	•996828		996828_	1.0°2538.	_1.004440-	_1.002538	_1.002538.	_1.000635_				
8 .7353-05	. 986535	•996814	1.020133	•991426	• 00'6814	1.018341	.991426	•995018					
	0.0.0011	ひいじついつ	ロカロフロフ	ロプオハハカ		1.020330	1.010552						
RADIAL FORCE PARAM	ETER RAFK	AND FORCE V	.985787 ECTOR ANGL	.977007	ASURLID COU	INTER-CLOCK		and the state of t	1.026083				
RADIAL FURCE PARAM	ETER RAFK		ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t					
	ETER RAFK	AND FORCE V	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t					
RADIAL FUNCE PARAM	ETER RAFK	AND FORCE V	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t					
RADIAL FORCE PARAM	ETER RAFK	AND FORCE V	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t					
RADIAL FORCE PARAM DATA RAFK POINT IN**2	ETER RAFK	AND FORCE V THETA = 0 THETA DEG	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2	ETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.707 2 .097920	ETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.300 2 .007.921 3 .092.22	ETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .165309 2 .097929 3 .09222 4 .06747	SETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .16530 2 .007921 3 .09222 4 .06747 5 .082236	ETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FURCE PARAM DATA RAFK POINT IN**2 1 .166305 2 .097721 - 3 .09222 4 .06747 5 .08223 6 .08496	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .007.92 3 .092.22 4 .067.77 5 .082.36 6 .080.99 7 .064.59	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .09792 3 .09222 4 .06747 5 .08223 6 .05049 7 .066.30 8 .07538	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 521.68	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .09792 3 .09222 4 .06747 5 .08223 6 .05049 7 .066.30 8 .07538	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 521.68	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .097920 3 .09222 4 .06797 5 .08236 6 .08099 7 .064.50 8 .075.38 9 .34820	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.68	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .09792 3 .09222 4 .06747 5 .08223 6 .05049 7 .066.30 8 .07538	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.68	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.30 2 .097920 3 .09222 4 .06797 5 .08236 6 .08099 7 .064.50 8 .075.38 9 .34820	EFTER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.68	ECTOR ANGL	E THETA.ME	ASURLID COU	INTER-CLOCK		and the state of t		•			
### PORCE PARAM DATA	SETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 49.24 34.88 321.88 .79.99	COEFF HE	E THETA ME MENTATION S	ASURED COU TATION 34	LOSS COEF	WISE WHEN	and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.305 2 .097721 3 .09222 4 .067477 5 .08236 6 .058496 7 .064348 8 .07538 9 .34820	SETER RAFK	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 521.68 .79.99	COEFF HE	E THETA ME	DEFF HEAD	LOSS COEF	WISE WHEN	and the state of t		•			
### POINT FORCE PARAMETER DATA RAFK POINT IN**2 1	SECOND S	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.88 79.99	COEFF HE	E THETA ME MENTATION S EAD LOSS CO IFF ONE DIP	DOTFF HEAD	LOSS COEF	WISE WHEN	and the state of t		•			
RADIAL FORCE PARAM DATA RAFK POINT IN**2 1 .166.309 2 .097.920 3 .092.22 4 .067.97 5 .08.23.06 6 .020.99 7 .064.500 8 .075.389 9 .348.200 DIFFUSION HOUSING	SECOND S DISCH MEAN T/RPM**2	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.88 .79.99 THEAD LOSS HOUSG ON	COEFF HE	E THETA ME SENTATION S EAD LOSS CO IFF ONE DI .1277	DOTF HEAD VOLUTI	LOSS COEFF	WISE WHEN	and the state of t		•			
### POINT RAFK POINT IN ** 2	SECOND S	AND FORCE V THETA = 0 THETA DEG 46.43 48.74 54.69 44.91 40.19 44.24 34.88 321.88 79.99	COEFF HE	E THETA ME MENTATION S EAD LOSS CO IFF ONE DIP	DOFF HEAD VOLUTE	LOSS COEFF	WISE WHEN	and the state of t		•			

-	:	• •								•				••		
									·							~~~~~~~~~~ ·
			·			<u>.</u>								· · · · · · · · · · · · · · · · · · ·		
											:		•			
				. *.		1					·		·			
•				4.				······································						<u> </u>		
	·	Martin Company of the								•						
				- Annaham ora Baltonian iliana												
				***************************************						•						ر. د
			•	,	•				-		•		•	•	••	P. 22
												-				
				-			······································							, a de de comerciano d delle . El Millelo De		
	<u> </u>	,												un de digue peur se constituença de terit ser e		
	,	**************************************			•				, <u>appare</u> , and order and acc desired		. Carrier and Printer and	uda ya din udawa ushingi sa miliki ki				and the second second
		*					,		*	e a paraging agreement apply and the self-the					,	
									٠.							
								<u> </u>								
					,,_ <u>,</u> ,			SPIN.	** ***********************************	**************************************	desperator e de come con e u se filoso.	**************************************		*2104-54 *2572-84 *2572-84 *3772-84		
	· 					·		. SEIN	د د امارسمت	3217		0623	• • • • • • • • • • • • • • • • • • • •	. 36-7046.		9

7. OVERALL PERFORMANCE OF A TWO-STAGE LIQUID HYDROGEN PUMP

COMPUTER PROGRAM

OVERALL PERFORMANCE OF A TWO-STAGE LIQUID HYDROGEN PUMP

I. INTRODUCTION

This program computes overall performance parameters of a two-stage liquid hydrogen pump. Inlet conditions and stage performance parameters in normalized form are input. Print-out includes overall isentropic head, discharge pressure, reheat factor, efficiency and power. This program makes extensive use of the liquid hydrogen property deck prepared from Reference 1.

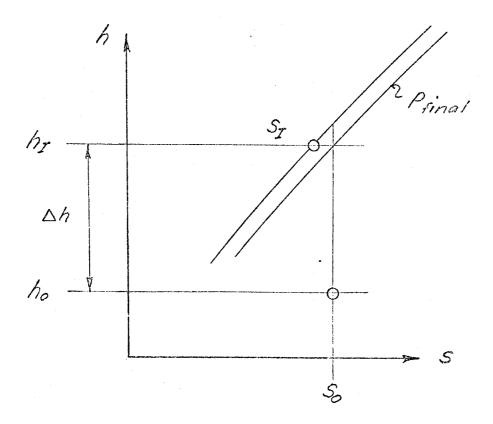
This program was used primarily for the computation of overall performance predictions for the NERVA two-stage pump. The undesired but not too severe scatter in reheat factors obtained resulted from inadequacies in the fluid property deck.

II. BASIC CALCULATIONS

The stage discharge pressure is determined from the specified isentropic head rise $\triangle h$ and the inlet entropy S_o defined by inlet temperature To and inlet pressure Po. In this program the stage discharge pressure is computed by subroutine PRETE. In PRETE, an initial pressure is first calculated using the fluid density at the inlet. The final pressure is obtained by iteration. Increments of pressure determined from the difference in entropies $S_o - S_i$ and the slope of the

line of constant pressure (see diagram below) are added to the initial pressure. The solution is satisfactory when:

$$S_0 - S_i \leq Specified Tolerance$$



The reheat factor herein defined as the ratio of the sum of the isentropic stage heads to the overall isentropic head rise is:

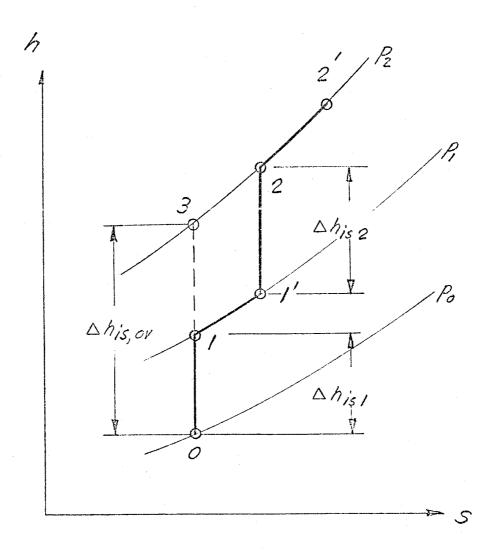
$$\mu = \frac{\sum \Delta h_{is,stage}}{\Delta h_{is, overall}} > 1.0$$

Reference 1 - NBS Report No. 9288 Cryogenic Engineering Laboratory
National Bureau of Standards, Boulder, Colorado,
18 August 1967

The overall efficiency of a multi-stage pump is then:

$$\eta_{\text{ov}} = \frac{1}{\mu} \eta_{\text{stage}}$$

assuming that the efficiency of all stages is the same.



After the end point 2' is determined (refer to above diagram), the overall isentropic head or the pump ideal head rise is obtained using the function HFUN. This function determines the enthalpy at point 3 from the discharge pressure at point 2 and the inlet entropy S_{0} by an iterative method similar to that of subroutine PRETE.

III. FLUID PROPERTY FUNCTIONS

The following liquid hydrogen property functions are used in the program:

PTENTH looks up enthalpy from pressure and temperature

PTENTR looks up entropy from pressure and temperature

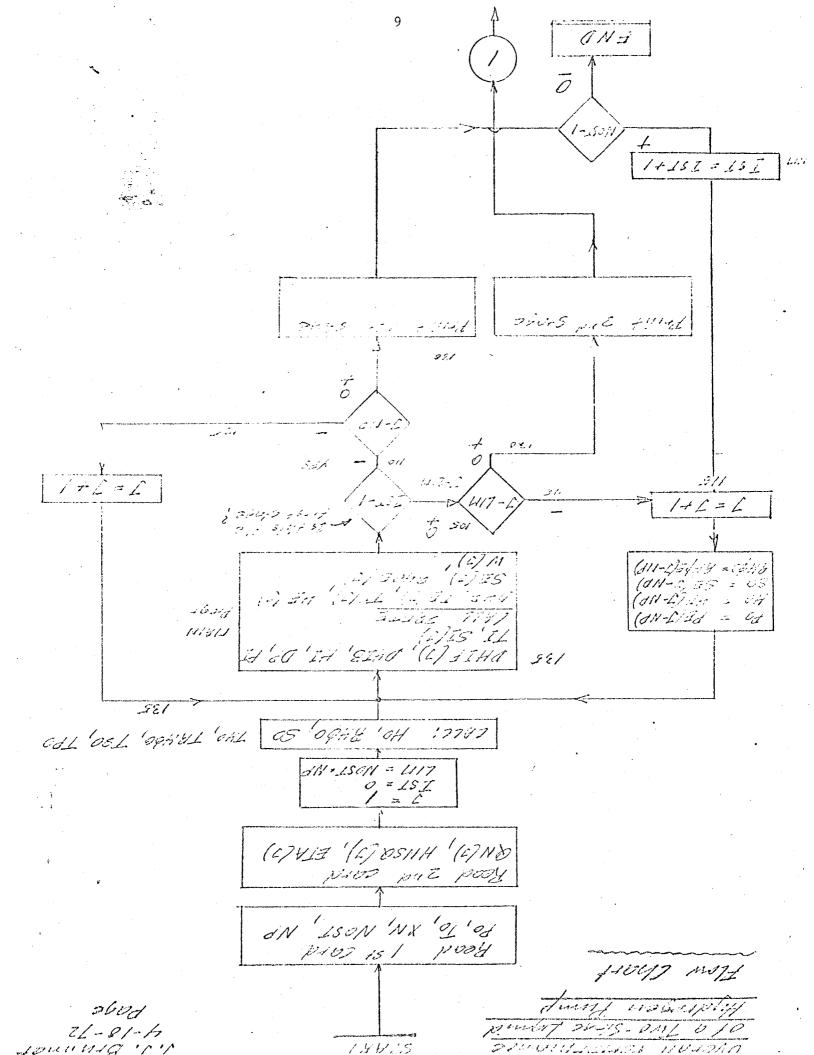
PHTEMP looks up temperature from pressure and enthalpy

PHDENS looks up density from pressure and enthalpy

A complete program listing and a sample print-out is presented on following pages.

NOMENCLATURE INPUT

SYMBOL	DESCRIPTION	UNITS	FORMAT
PO	Inlet Pressure	psia	F
ТО	Inlet Temperature	DEGR	F *
XN	Rotational Speed	RPM	F
NOST	Number of Stages	_	I 4
NP	Number of Data Points (Q/N)	-	I 4
First and Se	cond Stage Parameters:		
QN	Flow Parameter Q/N	GPM/RPM	F
HNSQ	Normalized Head H/N ²	FT/(RPM) ²	E
ETA	Efficiency	_	F ·



```
HIOV(7) = HEUN(PE(THK), To, SO)
RHF() = (HI() + HI(J+K))/HIOV()
ETAOV(7)
    HP, TRQ, TRQN
```

END.

GX28-7327-6 U/M050 FORTRAN Coding Form Printed in U.S.A. NORTH OVERALL PERFORMANCE OF A TWO-Stage Liquid GRAPHIC PAGE PUNCHING CARD ELECTRO NUMBER INSTRUCTIONS PUNCH IDENTIFICATION SEQUENCE Statement FORTRAN STATEMENT Liuma e 1 st stage stack as many as NP indicates QN MNSQ HNSQ 1 : 1 1 :

1: 11 12 13 14 15 16 17 18 19 70 21 27 23 24 25 76 27 28 27 30 31 32 33 36 35 16 37 39 39 40 41 42 43 44 45 45 45 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 65 77 65

```
29 SEP 71 12:59:01.013
  AT FOR PRETE
  UNIVAC 1198 FORTRAN V LEVEL 2296 0018 F50188
  THIS COMPILATION WAS DONE ON 29 SEP 71 AT 12:59:01
     SUBROUTINE PRETE
                       ENTRY POINT 000105
STORAGE USED (BLOCK, NAME, LENGTH)
          0001 +CODE 900126
         - 98000 --- 4740 -- 000032 -
          0002 *BLANK 000000
     EXTERNAL REFERENCES (BLOCK, NAME)
         0003 PHTEMP
          0004 PTENTR
      ---- 2005 -- NWDUS -- --
          0006 NI025
          Ø007 NSTOPS
          -0210 --- NERR35 ----
     STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)
3301 - 000007 10L---
                         ଜ୍ୟରୀ ସ୍ଥ୍ୟର 5al ହେଉଡ଼ା ହେଉଡ଼େ COUNT ପ୍ରତ୍ତ R ଅଧ୍ୟୟରେ DP ଅନ୍ୟୁ ନ ଅନ୍ୟୁଦ୍ୟ DS
     3081 888858 40L
                                                                        0030 R 003054 Q
                                                                                              0200 R 000005 8
                           0003 R 000000 PHTEMP
                                                  0004 R 000000 PTENTR
      0000 R 000001 P
     0300 R 080037 SLOPE ..... 0000 R 000003 T.....
                     SUBROUTINE PRETE(HI, PI, TI, SØ, SI)
                  INTEGER COUNT
                 100 FORMAT(/2X, ING SOLUTION IN PRETE!)
  20104
           3 .
  22125
           4 *
                     COUNT # 1
                 P # PI + 20.
---- 02106 ---- 5.
  32197
           5*
                  DP = P - PI
  00110 .
           7+
                  10 T = PHTEMP(P,HI,Q)
---- 83111-
                   ___S # PTENTR(P.T)
  03112
          Q 🕳
                     DS = SI = S
  00113
          10+
                     IF(OS) 25,20,25
                  -25 -SLOPE = DP/DS ----
 _ 00115_
         ....114-
  00117
                     IF(ABS(SI/S0-1.)-1.E-05) 20,20,30
         12+
                  30 IF (COUNT - 15) 40,50,50
  23122
         13*
 __ 00125 ___ 14+ __
                 __40 COUNT = COUNT + 1----
  00126
        15+
                     SI s S
 03127
       . 16*
                     DP # SLOPE + (SI-SO)
                   ......P . # . DP ......
___ 00130 ___ 17*-
                  GO TO 10
  33131 18*
         19*
                  50 WRITE( 6,100)
  38132
  20134 ____ 204_
                  ___STOP ...___
                  20 PI = P'
  23135
         21+
          22*
                   TI = T
  32138
--- 00137 --- 23+-
                   ---- RETURN-
```

```
CI FOR HEUN

LYSYAC 1108 FORTRAN V LEVEL 12206 0018 F50185 -----
  THIS COMPILATION WAS DONE ON 29 SEP 71 AT 12:59:00
    FUNCTION HEUN ENTRY POINT 000106
STORAGE USED (BLOCK, NAME, LENGTH)
          2221 +CODE 200123
       8802 +BLANK 000000
    EXTERNAL REFERENCES (BLOCK, NAME)
         and the second           9923 PTENTR
          edså PTENTH
      ____ 0005 ___ NWDUS
          9925 NIO25
          9997 NSTOPS
          0010 .... NERR35 .....
    STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)
     0399 - 039013 10F - 3001 - 000042 100L - 0001 - 000047 150L - 0001 - 000062 160L - 0001 - 000071 200L
     0031 000014 53L 2001 000025 50L 0000 1 000001 COUNT 0000 R 000000 B 0000 R 000004 DT 0000 R 000000 PTENTR 0000 R 000000 R 00000 R 000000 S21
  2002 R 300025 S22 .... 3600 R 600063 T
                  FUNCTION MFUN(P2,T1,S1)
  80181
  20103 ____2* INTEGER COUNT .
  20104 3+ 10 FORMAT(/2X, INO SOLUTION OR S2 4 S1 IN HEUN!)
                COUNT = 1
  00105
                 ____ S21 = PTENTR(P2,T1) ------
___5*__
  00107 6+ T = T1 + 0.5
00110 7+ DT = T-T1
                  52...522 * PTENTR(P2,T).....
___02111_____8*__
                DS # 522 - 321
  00112 9*
                     IF(DS) 60,200,60
         18*
  02113
                 ___ 60 SLOPE # DT/DS .....
___ 07116 ____11+__
                   IF(A83(1.-322/S1)-1.E-05) 200,200,100
  Ø£117
        12*
                 100 IF (COUNT-30) 150,160,160
  01122
         13+
80125 14+ 150 COUNT = COUNT + 1
         15* $21 = 922
  20126
                     DT # SLOPE*(S1-522)
  02127
          15+
                   .....T = T+DT ...
         ... 17+...
  80138 -
        18+
                   GO TO 50
  00131
         19* 160 WRITE( 6,10)
  $1132
  0:134 .....22+ ..... STOP
          21+ 202 HFUN = PTENTH(P2,T)
  29135
                  RETURN
   20135
          22.
                   END
   23137
          23+ -----
```

```
MIAM SCR IN
  UNIVAC 1106 FORTRAN V LEVEL 2206 0018 F50185
  THIS COMPILATION WAS DONE ON 29 SEP 71 AT 12:59:02
  HAIN PROGRAM
STORAGE USED (BLOCK, NAME, LENGTH)
         0001
              +CODE
        --- 3300 --- +DAT4 --- 301760
         0002 +BLANK 030003
    EXTERNAL REFERENCES (BLOCK, NAME)
         0003
              PIENTR
         0004
     ___. 2235 __ PHDENS
         0006
              PHTEMP
         0007
               PRETE
         0019 ..... HFUN ....
         2311
         0712
         0013
             ....NID15
              NWDUS
         0014
              NSTOPS
         0015
   STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)
                                                                                   0000
                                                                                        001351 11F
                                                                0201
                                                                     000302 105L
                                            0000
                                                 001263 100F
          091265 1F
                         0323 301261 10F
     0003
                                                                                   0000
                                                                                        . 001365 13F
                                            _0001 ___000517 120L
                                                              ____0001_
                                                                    ___ 000314_125L
         _. 6001
                                                                                  0001
                                                                                         000373 1451
                                                                0001
                                                                     333427 140L
                                            0000 001417 14F
                         0001 020161 1351
     0031
          000320 130L
                                                                                   3900
                                                                                         331473 17F
                                                 000035 157G
                                                                0330
                                                                    001453 167
                         3088 901438 15F
                                            ធាលាខា1
           302484 147L
                                                                                 ____ 0381____003326_220U
                                            331525 19F ...... 3330 .... 321327 2F .....
  1__ 2333
                                                                                   6666
                                                                                         001312 3F
                                                 001605 27F
000451 335G
                                                                0001
                                                                    000347 278G
                              901577 25F
                                            ଷ୍ଟ୍ରୀଷ
                      : ଓଡ଼େଶ୍
     caga
           001570 23F
                                                                                         001628 37F
                                                                     001623 35F
                                                                                   3323
                                                  000451 335G
                                                                0000
                              020415 315G
                                            0001
           001613 31F
                        2001
                                                                                  __ 0330 ___ 081710_43F __
                       .... 030552 370G .
                                                                     331725 47F 8383
                                                                                         881737 498
                                                                8020
                                            ମ୍ୟା ପ୍ରଥମ୍ୟ 456G
                     201712 45P
     0001
         333636 439G
                                                                     001355 8F
                                                                                         030756 998L
                                                                                   0001
                                                  001344 7F
                                                                0000
                                            0000
                         9999
                              001323 6F
          031316 5F
                                           3J31. . 832767 999L...
                      _____ 0000 R 001072 DHB
                                                                0000 R 000512 ETAOV 0000 R 000264 HE
                                            0000 R 000132 ETA
                         201247 DP
     0233 R 022644 DHIOF
                                                                                    0300 R 000336 HNSQ
                                                                0000 R 000416 HIOV
                                            0000 R 001165 HION
                        10000 R 001246 HI
     3313 R 030000 HFUN
   ____0000 I_001255_KS.__
                                                                                  0000 I 001232 NP
                         aeaa I 801224 LR
     0000 I 001233 LIM
                                                                                   0000 R 001250 PI
                         0000 R 000170 PE
     3333 R 331241 OMEG
   0000 R 000776 QN 0000 R 000454 RHF 0000 R 0003560 RHOE 0000 R 001237 RHOU 0000 R 001240 RL0 0000 R 000322 SE 0000 R 000074 SI 0000 R 001236 SD
     2030 R 201257 GII
     0300 R 001254 RLE
                                                                                  ____ØØØØ_R.ØØØ553_TORQ
                                                              ____0000..R-001251--TI-
                                            --- 0000-R- 001244-TH0---
                         0000-R-000226-TE----
  0000 R 001242 TT0 0000 R 001227 T0
                                                                               ୍ ଜଣ୍ଡଥ R ଉଡ଼1256 Tଡଠ
                         0000 R 001243 TS0
     0000 R 000606 TORON
                         0000 R 001230 XN
     000740 WDOT
                   DIMENSION DHIF (30), HNSQ (30), SI (30), ETA (30), PE (30), TE (30), HE (30),
   03121
```

```
PH . BHT
                                                                                                    03515
                                                                            48 # 051
                                                                                             # 0:9
                                                                                                   - 11200
                                                                            d1 . 011
                                                                                             #69
                                                                                                   63573
                                                                                             #89
                                                                                                    Z0203
                                                                OHEC # $ 18472 + XM
                                                                                             # Z G
                                                                                                  E2539 ----
                                                   8400 = $40E/3(60'40'40'0 - 1158'
                                                                                                  60205....
                                                                                             +00
                                                                 SO = PIENTR(PO.TS)
                                                                                                    00500
                                                                 HG = PIENTH(PG,TG)
                                                      WRITE(LY,8) PO.TO.XV,NOST,NP
                                                                                             # 7 G
                                                                                                   # SZ160
                                                                                             +29
                                                                         (K,WJ) BTIRW
                                                                                                    62109
                                                                                             e29
                                                                                                    17100
                                                                         MRITE(LV, A)
                                                                                             + I G
                                                                                                  ---Z9100
                                                                        MRITE(LY,5)
                                                                        WRITE(LW,1)
                                                                                             +ØG
                                                                                                    59100
                                                                                             +67
                                                                                                    69103
                                          S28 READ(LR;3) (QN(J), HNSG(J), ETA(J), Jul, LIM)
                                                                                                   09125
                                                              IE(63) 600'000'558 :
                                                                                             489
                                                                                             +17
                                                                    LIM = NEST + NP
                                                                                                    19100
                                                       200 READ(LRIZ) PO.TO.XV.NOST.NP
                                                                                             +05
                                                                                                    00145
                                                                                                   20141--
                                                                                             * S 7
                                                                   49 FORMAT(2X,F15,7)
                                                                                             ***
                                                                                                   07100
                               A7 FORMATICAX, 18TU/LB1, 8X, 18TU/LB/DEC R1, 6X, 1LB/F1#31/)
                      45 FORMATICVEX, LENTHALPY HOL, 5X, TENTROPY SOL, 5X, TOENSTTY RHOOL)
                                                                                             489
                                                                                                    00731
                                                                                           T5+ --
                                                                                                  ----98100
                                                                  43 FORMAT( 3F15.4//)
                           A1 FORMAT (F15.3,F11.1,E13,4,2F9.4,F11.4,F10.1,F12.2,F15.4/)
                                                                                             +10
                                                                                                    95130
                                                             [[8:"6x, 3FTLB/RPM++2:/)
                                                                                             407
                                                                                                    PETCO
                39 FORMATIC XX, 16PH/RPM1,3X, 1813E, FT1,16X, 1CHECKI; 5X, 1FACTOR1,25X, 18T-
                                                                                                   -- belou
                                                                                             *8E
                          1.3X, IEFFICIENCY, 3X, POWER, 4X, TOROUE, 5X, INDRM TOROUE!)
                                                                                                    63132
                37 FORMATCIOX, 19701, 4X, 11SENT HEADI, 3X, 1HIS/N**21, 5X, 1501, 6X, 1REHEATI
                                                                                             +18
                                                                                                    66168
                                               36 FORMAT(VASK, LOVERALL, PERFORMANCE!/V)
                                                                                            ---- + U.S.
                                                                                                    50105
                                                      27 ECSWYI(\\SX'; RECOND RIVEE:\\)
                                                                                             * G £
                                                                                                    10103
                                                                                                    65169
                                            27 FORMAT(F15,3,F12,3,F15,3,F18,3,3F15,3/1)
                                                                                             405
                                                                                                  $0155 ---
                                            23 FORMAT(F15.3, E13.4, F12, 4, F12, 1, F12, 4, 2F12, 3/)
                                                                                             25+
                                                                                                    92129
                                                                                             +15
                                                                                                    $2100
                                                                                                            2.
                                                       IDX*:BLOVEBYR'\XX*:IRVE1*X6$
                24+ ----ST E3847[(\X'|@BX\8bW|'VX'|DHIB' BIN\F9|'2X'|DHS'8IN\F8|'\XX'|BIN\F9|'--
                                                                                                   92162
                                 1Y HELLAX, FENTROPY SFL, 6X, LOENSITYL, 7X, FLOW RATELS
                                                                                             +68
                                                                                                    23154
                19 FORMATCIAX, 10/MI, 5X, 1ENTHALPY RISEI, 3X, 1ENTHALPY RISEI, 5X, 1ENTHALP
                                                                                             462
                                                                                                    $5150
                                                                                                  - 22160
                                       1/18/81 TOOM! (X3,15++19/81, x3,18/81/UT81, x2)
                                                                                             473
                17 FORMAT(ZX, GPM/RPWI, 4X, 10HIR, BTU/LEI, 5X, 10HE, BTU/LEI, 7X, 18TU/LEI,
                                                                                             498
                                                                                                   60100
                                                                                             524
                                                                                                    00155
                                                                  TEL'EX'IDISCHARGEL)
                                                                                        S ....
                                                                                                  00155---
            10 FORMAT(V/SDX, ISENTROPIC:, 7X, ACTUAL:, 10X, OISCHARGE!, 6X, DISCHARG
                                                IN HEI'YK', ENIBOBN SEI'RK', DENSIIK,)
                                                                                             53*
                                                                                                    12166
                16 FORMAT(10X, 10/N1, 5X, 1ENTHALPY RISE1, 3X, 1ENTHALPY RISE1, 5X, 1ENTHALP
                                                                                             55*
                                                                                                    12100
                                                               ST# ---- TIBRIVI'LX' LOER BIN) -
                                                                                                    00153
                  14 FORMATC 7X, GPM/RPM1, 4X, FT/RPM++21, 18X, FFT, 7X, BTU/L8/DEG', 5X,
                                                                                             50 •
                                                                                                    63163
                                                     TEX' LOWERRANGE DEL' 2X' LLEMB LEL)
                                                                                             +61
                                                                                                    Z1100
              13 FCRNATC 10X, 10X41, 7X, 1H/N++21,9X, 1ETA1,4X, 1HEAD RISE1,8X, 1SI1, ------
                                                                                            -----
                                                                                                  -- ZIIE3
                                                                                         11 4Z1 11 1191102
                                                        II FCRMAT(V/2X, FFIRST STAGE!//)
                                                                                             +91
                                                                                                    SILCO
                                                        8 FORMAT(PF15,3,F15,1,10,115)
7 PORNAT(( 6X, 190, PSIA), 5X, 110, DEG RI, 8X, 18PMI/)
                                                                                            -- + G I
                                                                                                  --- 71102
                                                            ICESI, AX, INO OF POINTSI/)
                                                                                             471
                                                                                                    61100
                                                                                             +51
                                                                                                    21103
                 6 PCRMATG 6X, 1PRESSURFI, 4X, 1TEMPERATUPE1, 5X, 1SPEED XN1, 5X, 1VO OF STA
                                                                                                  ---- 21125
                         5 FCRMAT(| 2X, 1 SUCTION CONDITION!/)
                                                                                            15+ --
                                                                                             + ; ;
                                                                                                    11100
                                                           3 FCRMAT(F10.4,E10.4,F10.4)
                                                                                             #DI
                                                                                                    ettes
                                                           2 FORMATC SFIG. 3. FIG. 1. 215)
                          DOISS. ... 9. ----- TORMANCE, BASED ON STAGE PERFORMANCELVIV.
                 T FORMAT(!!!. ASX, ! MULTISTAGE LIQUID HYDROGEN PUMP!/37X, ! DVERALL PERF
                                                                                                    20:03
                                                                                                   90100
                                                                    ING FORMATICEX, E10.4)
                                                                    -- 10 FCRMAT(2X,F15,5)
                                                                                           --- geree
                                                                                                    20163
                                                                                PMMT
                                                                                                    00100
                                                                                CHHT
                                                                                            - *6 --- 10160
                - (95) NOIH, (95) 994, (95) BHG, (85) BIHO, (85) NO, (85) TOW, (85) 9H, (85) ROIHOS
                                                                                             +2
                                                                                                    10102
                     1SE(33), RHOE(38), HIOV(38), RHP(38), ETLOV(38), TCR2(38), TORGN(58),
```

```
002:3
 _ 23214
        .... 63 .....
                      IST = 0
  00215
           64+
                      WRITE(LW, 45)
           55≠
                      WRITE(LW, 47)
  38217
                  ____ WRITE(LW.43) HO.SO.RHOD ____
  15566-
          - 55 ---
          67 ÷
                135 DHIF(J) = HNSQ(J) + XN++2
  00226
  90227
                      DHIR(J) = DHIF(J)/778,26
           483
---- 0223A
                  ...... HI * HØ * DHIB(J)
                      DP # RH00/144. * DHIF(J)
  00231
          73+
  00232
          71+
                    ---TI = PHTEMP(PI, HT, QI)---
---- 20233---- 72*·
                      SI(J) = PTENTR(PI,TI)
  00234
         73+
  00235
                      CALL PRETE(HI, PI, TI, SØ, SI(J))
                     DHB(J) = DHIB(J)/ETA(J)
.... 20236 ---- 75*
                      HE(J) \Rightarrow HØ + OHS(J)
  00237
          75*
                      PE(J) # PI
  20240
          77 +
                  TE(J) = PHTEMP(PE(J).HE(J).GE)---
---- 00241 ---- 78+ -
                      SE(J) = PTENTR(PE(J), TE(J))
  00242
          79+
                      REDE(J) = PHDENS(PE(J), HE(J), RLE) +1728.
  20245
                   ..... 36244....
          81 -
  00245
           82*
                      IF(IST-1) 110,105,105
  02253
           83*
                  185 IF(J=LIM) 115,128,128
 _.. 20253 .....
          84+ _.
                 ___110 IF(J=NP) 125,130,130
  00256
                  125 J#J+1
           83*
  00257
                      GC 70 135
           86+
  22233
        WRITE(LW,13)
  03262
                      WRITE(LW,14)
  02284
                   88265
          9.3 *
                 . 13=1.NP1
  83255
           C f 🛊
  20302
           92.
                      WRITE(LW, 16)
  20004 ....
          93* _
                    00337
           94*
                  145 WRITE(LW.15)
  20311
           95*
                      WEITE(LW.21)
                 WEITE(LW.25) (QN(J).DHIB(J).DHB(J).HE(J).SE(J).RHOE(J).Ja1.NP)
 _ 00313
           95+ ...
  32335
           97.
                   GC TG 147
                  140 WFITE(LW.19)
   60327
           OAL
                 WRITE(LW,17)
  20331 .
          00 *
                      WRITE(LW.27) (QN(J).DHIB(J).DHB(J),HE(J).SE(J).RHOE(J).WDOT(J).J#1
  29333
          133*
                     1.191
  92333
          121+
..... 33347----132*-
                   ---- GC TO 993 ----
  20339 103*
                  147 IST = IST + 1 .
   00351
                      KS # IST * NP + 1
        104 •
____22352___105+_
                  _115.J=J+1
   00353
                      PR = PE(J=NP)
         136*
                      HO = HE(J+NP)
   00354
  20355 ....
                     _ SØ: = SE(J=NP) ____
                      RHD2 = RHOE(J=NP)
   03356
         129+
   03357
         112+
                      GO TO 135
                 ___ 120 WRITE(LW.31) _____
____ 00368 _ 111* -
  00362 112*
                      WRITE(LW.13)
                      WRITE(LW.14)
   20354
         113+
                     __write(LW,23)_(QN(J),HNSQ(J),ETA(J),DHIF(J),SI(J),PE(J),TE(J),_
---- B0356----114+--
  00355
                     1J=KS.LIM)
         115+
  00432
         116+
                      WRITE(LW,16)
......90404......117*-
                     _WRITE(LW,19)
   88436
         118*
                      WRITE(LW,17)
                      WRITE(LW,27) (QN(J),DHIB(J),DHB(J),HE(J),SE(J),RHOE(J),WDOT(J),J#K
   00410
         119+
  92413 --- 1234-
   00424 121*
                      SO . TSO
```

```
TA: # TT2
   20435 122€
-- 38425 -- 123-
                --- --- - HE # TH2
          124+
                       00 153 Ja1.KP
   00427
   23432
                        HIOV(J) = HFUN(PE(J+NP), TØ.SØ)
          125+
          -125∗
                        TEO - PHTEMP(PE(J+NP), HIOV(J), QII)----
 - 23433
   03434
          127*
                        SOC(J) = PTENTR(PE(J+NP).TOO)
                        DHIOB = HIOV(J) = HO
   00435
           128*
                   --- DHIOF(J) = DHIOB + 778.26
--- 00435
         129+ ---
                       HION(J) = DHIOF(J)/XN++2
   20437
          138+
   03443
          131+
                        RHF(J) = (DHIF(J) + DHIF(J+NP))/DHIOF(J)
                    ---- ETAOV(J) =DHIOF(J)/(DHIF(J)/ETA(J)*DHIF(J+NP)/ETA(J+NP))-
--- 22441-
         .... 132*
                        HP(J) = DHIOF(J) + WDOT(J) /550. /ETAOV(J)
   20442
          133 •
   00443
          134+
                        TORO(J) = 550. * HP(J)/OMEG
                  --- 150 TORON(J) = TORQ(J)/XN++2
 - 20444
          -135*
   00445
          136 €
                       WRITE(LW,35)
                        WRITE(LW,37)
           137+
   03450
                -----WRITE(LW,39)
--- 03452
          138*
                       WRITE(LW.41) (QN(J), DHIOF(J), HION(J), SOO(J), RHF(J), ETAQV(J), HP(J),
   03454
          139*
                      iTORG(J), TORGN(J), J=1,NP)
   03454
          149+
                   -992 CONTINUE
---- 33472
          141+
   69473
          142+
                       GO TO 200
                   999 8107
   00474
          143*
- - 32475
         144 .....
                       END ...
          END OF UNIVAC 1188 FORTRAN V COMPILATION. Ø +DIAGNOSTIC+ MESSAGE(S)
```

MULTESTAGE LEQUID HYDREGEN PUMP OVERALL PERFORMANCE DASED ON STAGE PERFORMANCE

1			OVERALL PE	FORMANCE BASE	ED ON STAGE	PERFORMAN	CE			• •
:		i							1 1 to 1 to 1	
	CHECKEN CONDIT	ומא								
:	# AU JUSTABLE	TEMPERATURE	SPEED XN	NO CF STAGES	NO CF FOI					
-	DC. PSIA	TO. DEG R.	RPM				pro representation and the second			:
	31*800 ·	36.400	27000.C	2	3					
	ENTHALPY HO	ENTROPY SO BTU/LB/DEG R	DENSITY RHO	10				: :		
_	-109.4985	1.8998	4.4160			er mer nærer i er skreke sekkresett år til 1. mil 1	and the second s	Security States of Security Se		
**	•						ž.	:		
c	FIRST STAGE					ger 1, 1, 15 - 15 - 15 - 15 - 15 - 15 - 15		A STATE OF THE STA		
12	GPW/ COM	FT/RPM**2	ETA HEAD				EMP TE EG R			COMPANY OF THE PROPERTY OF THE
	0.105	0.3780E-04	0.7100 27	7556.2	3999 880	.601	47.130	The state of the s		
2	. 0 • 3.50	0.3500E-04	0.7250 25	5515.0 1.8	8998 809	•419	45.993			
	0.790	0.2850F-CA	r.6400 20	776.51.	8998660	•513	46.321	an analyza and a series of the		
10										
c	G/N GPM/RPM	ISENTROPIC FNTHALPY RISE DHIR. BTUVLB	AC TUAL ENTHALPY RISE DHB.B TUVLB	DI SCHAR ENTHALPY BTU/LB	GECISC HE ENTRO BTU/L	HARGE PY SE B/R	DISCHARGE DENSITY LB/FT**3		*	
	0.195	35.407	45.87C	-60.029	2.	223	4 • 477			
2	m 0 • 220	32.788	45.220	-64.678	2.	187	4.477	1		
		26.696	41.713	68.186	2.	254	4.395		11 A 11 A1A A1 1 - W 11 A1A A1A	
1.0										
	SECOND STAGE								The second second second second second	
.>	GPM PPM	H/N**2 FT/RPM**2	ETA HEAD	RISE S	I PRESSU /DEG PS I	RE PE T	EMP TE	en cultura a fra manta di tare		perior and a side de
0	0.195	0.36205-04	0.6880 26	3399.8 2	2234 1728	•537	57.840			•
ļ	0.220	0 . 3420E- 04		931 • 8 2 •	18691614	.3:.4	55 •965	and the second s		
c	0 • 290	0.2730E-0A	0.6410 15	9901.7 2.5	2541 1272	•553	55.556	i		
0	O/N GPM/REM	ISENTROPIC ENTHALPY RISE DHIE, STUZLE	ACTUAL ENTHALPY RISE DHE BTU/LB	DI SCHAR ENTHAL DY B TUZLB	GE CISC HE ENTRO	HARGE PY 5 E B/R	DISCHARGE DENSITY B/FT**3	FLDW RATE		
0	0.195	33.909	49.286	-10.743	2.	50ti	4.531	53.155		
	0.220	32.035	46.094	-19.584		453	4.543	60.122		
2	. / 0.290	25.572	29.894	-28.292	2•	531	4.392	76.621		•
0	CVERALL PERFORM	IANCE							34	
	GPM/BEW GNN	ISENT HEAD RISE	INLET ENTROPY	REHEAT FACTOR E	CVERALL FFICIENCY	POWER HP	TURQUE FTLB	NORM TORQUE FTLB/RPM**2		
Ì	0.195 .	52948.5	. 1.8866	1.0188	0.685	7369.6	1433.56	0.19660-05	e e	*
	0.220	49533.8	1.8878	1.0184	€ •697	7655.8	1489.22	0.20438-05		
*	* , ***	sanka, ĝ	1 12-036	1.0376	0.617	80M246	1701.200	↑. 10 / 10 # #		and the second control of the second control

8. CROSSOVER PASSAGE DESIGN

COMPUTER PROGRAM CROSSOVER PASSAGE DESIGN

I. INTRODUCTION

This program presents a method for determining the passage surface shapes of crossover channels employed in multistage pumps. The meridional velocity as well as the tangential velocity distribution are prescribed as a function of meridional stream line length. Coordinates defining the channel shape along the mean line are calculated. Suction and pressure surface velocities are estimated from momentum considerations assuming a linear velocity distribution from the suction surface to the pressure surface of the passage.

The method of analysis employed was devised by M. C. Huppert and the program was first used to smooth out the crossover passages of the 2nd stage NERVA Turbopump discussed in Reference 1.

II. BASIC EQUATIONS

The tangential velocity distribution is described in the following way:

$$RC_{u} = R_{1} C_{u1} + [R2 Cu - R1 Cu_{1}] \underbrace{Y^{n} (2 - Y^{n})}_{f}$$
 (1)

where:

R1 Cu_1 = whirl at inlet of crossover passage

 $R2 Cu_2$ = whirl at exit of crossover passage

f = whirl distribution factor

Y = $\frac{m}{M}$ ratio of passage length to total passage length in meridional plane.

m = distance along mean line of crossover passage in the meridional plane.

M = Total length of crossover passage in the meridional plane.

n = Exponent to specify whirl distribution (surface loading)

Reference 1 - Aerojet Nuclear Systems Company, Engineering Operations Report N8300R:71-076, NERVA Turbopump Design Report, Volume 1, September 1971

The whirl distribution factor f is plotted in Figure 1 as a function of Y for two values of n.

The geometry of typical pump crossover passages are depicted in Figures 2 and 3.

The meridional velocity distribution is directly input ($C_{\rm m}$ on card 2; refer to input format).

The tangential width of the crossover passage A is computed from continuity as follows:

$$A = \frac{Q}{Z B C_m}$$
 (2)

where:

Q = total flow, ft^3/s

B = meridional width of the crossover passage

Z = number of passages

The angle of the mean streamline of the crossover passage β is determined from C_m and the value of C_u obtained from expression (1).

$$\tan \beta = \frac{C_{m}}{C_{U}}$$

The wrap angle of the mean flow surface of the crossover passage is then given by:

$$\theta_{\rm m} = \frac{180}{\Pi} \, M \, \int \frac{\rm dx}{R \, \tan \, \beta}$$
 (3)

and the wrap angles of the passage surfaces are:

Suction Surface

$$\theta_s = \theta_m - \frac{A}{2R} \frac{180}{II}$$

Pressure Surface

$$\theta_{\mathbf{p}} = \theta + \frac{A}{2R} \frac{180}{11}$$

Suction and pressure surface velocities on the mean streamline are estimated from momentum considerations.

$$H_p - H_s = \frac{Q}{g R B m Z} \frac{\partial (R C_u)}{\partial X}$$
 (4)

 H_p = pressure surface static head, ft

 H_c = suction surface static head, ft

The rate of change in which $\frac{\partial (R C_U)}{\partial X}$ is obtained by differentiation of expression (1).

Thus:

$$\frac{\partial (R C_u)}{\partial X} = (R_2 Cu_2 - R_1 Cu_1) 2nX^{n-1} (1 - X^n)$$
 (5)

Assuming constant total head (no losses) the surface velocities are:

$$H_p - H_s = \frac{C_s^2 - C_p^2}{2 q} = (C_s - C_p) \frac{C_{Ave}}{g}$$
 (6)

where:

$$c_{Ave.} = \sqrt{c_m^2 + c_u^2}$$

2-81-17

1 24116/4

1 = 4 sacrossed some sers set

z = u z =

 $\frac{(u\lambda^{-2})u\lambda}{-2(u\lambda^{-1})^{-1}} = f$

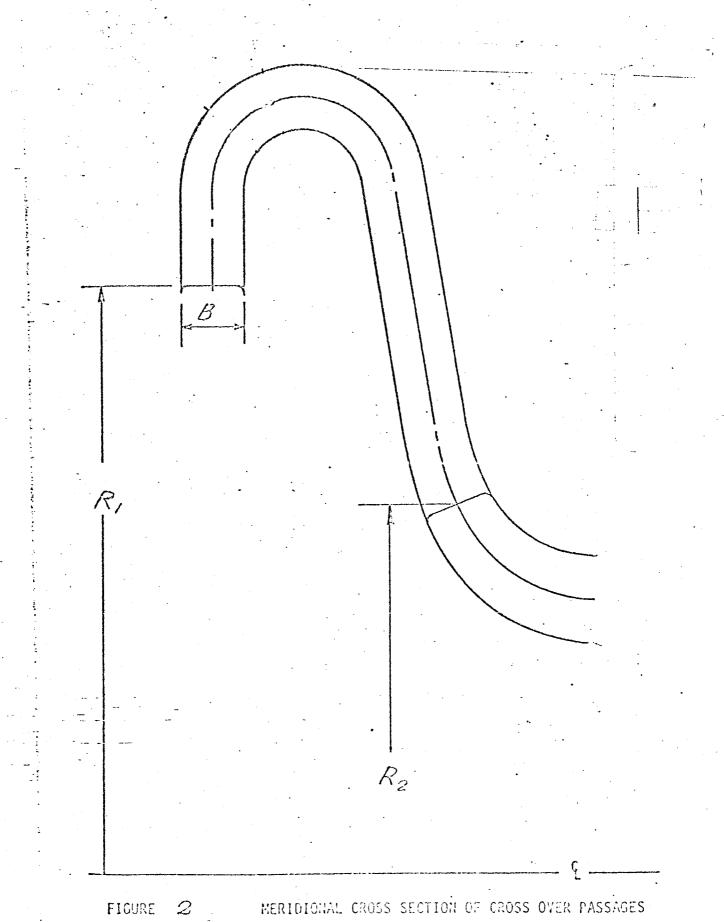
Assuming a linear velocity distribution in the passage from the suction surface to the pressure surface the surface velocities $\mathbf{C_s}$ and $\mathbf{C_p}$ are:

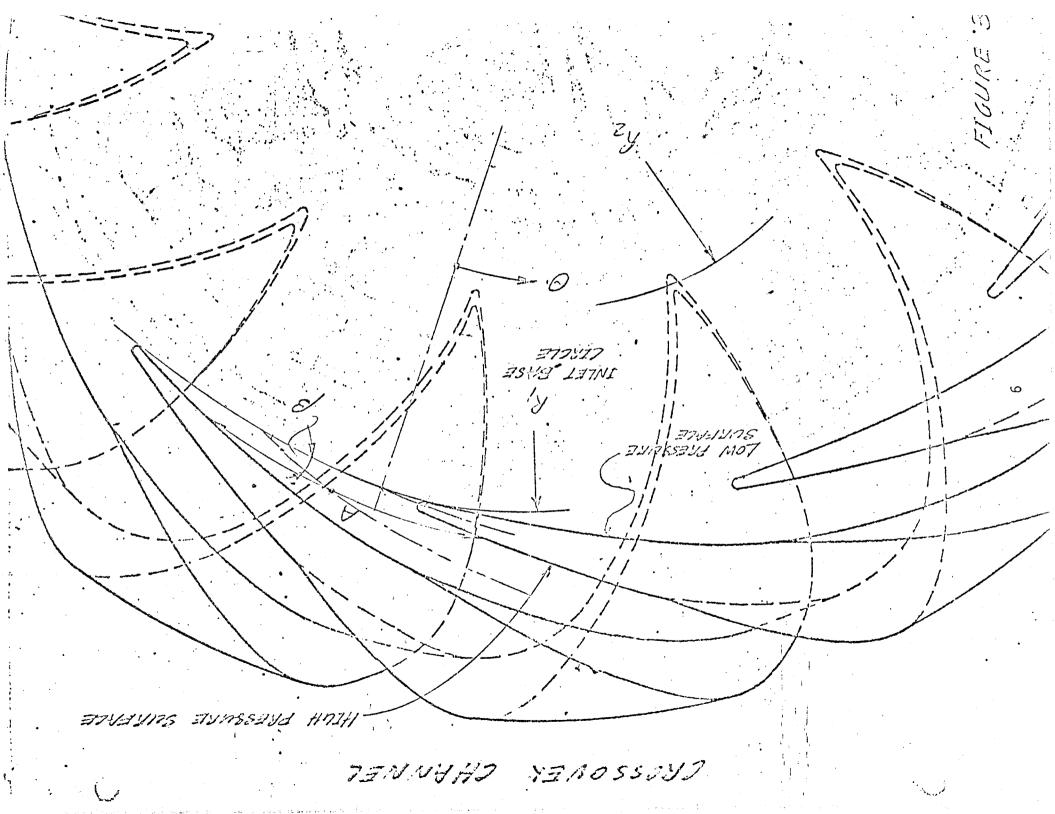
$$C_s = C_{Ave} + \frac{C_s - C_p}{2}$$

and

$$c_p = c_{Ave} - \frac{c_s - c_p}{2}$$

A complete listing and a sample printout are presented on the following pages.





MILI

FORTRAN Coding Form

GX28-7327-6 U/M050 Printed in U.S.A. 0100000 N91830 3548'8'Vd 837(US)S

Amonda Long Language of the company of the condens when t							+				1	_ :					
Moment and a state of the second of the seco																	
Moment deline: (A) = Inlet Rodius (A) = Inlet		-		1					1 1 1 1						: : !		
Momens and some of the solution of the solutio		- -	-	1	7 = 9	sof 700	14 26 p.	7401	53454								
Monism Collings (All = Mingentrial Composent, inlet absolute velocity, tilloce (CUL = Mingentrial Composent, inlet absolute absolute velocity, tilloce (CUL = Mingentrial Composent, inches (CUL = Mingentrial Composent,	,																
Adminol Component, inter absolute viccity, filecity, filect	· _			- 	07=7	101710	11 5111	504									
Momens at solding Companies, inlet absolute velocity, tilesco										zzqumi.	nod no	iidu 157-	OE) 7	(xvx			
Momens at the Reddius R1 = Inlet Reddius CUSA = Tangential Component, inlet absolute absolute velocity, tilsac CUSA = Tangential Component, inches absolute velocity, tilsac CUSA = Tangential Component, inches absolute velocity, tilsac TM = Total parcage Length, inches		-			4=0	Mauin	MOIS	25/27									
Momens lature: (1) = Inlet Redius (2) = Inlet Redius (2) = Inlet Redius (2) = Inlet Redius (2) = Inlet Redius (3) = Inlet Redius (4) = Inlet Redius (4) = Inlet Redius (5) = Inlet Redius (6) = Inlet Redius (7) = Inlet Redius (8) = Inlet Redius (9) = Inlet Redius (1) = Inlet Redius (2) = Inlet Redius (3) = Inlet Redius (4) = Inlet Redius (4) = Inlet Redius (5) = Inlet Redius (6) = Inlet Redius (7) = Inlet Redius (8) = Inlet Redius (9) = Inlet Redius (1) = Inlet Redius (2) = Inlet Redius (3) = Inlet Redius (4) = Inlet Redius (5) = Inlet Redius (6) = Inlet Redius (7) = Inlet Redius (8) = Inlet Redius (9) = Inlet Redius (1) = Inlet Redius (2) = Inlet Redius (3) = Inlet Redius (4) = Inlet Redius (5) = Inlet Redius (6) = Inlet Redius (7) = Inlet Redius (8) = Inlet Redius (8) = Inlet Redius (9) = Inlet Redius (9) = Inlet Redius (9) = Inlet Redius (1) = Inle					N=Z - NL	d jujo)	260534	4.5.12)	824241								
Nomenclastics Components inlet absolute volceity, Alsec		-			כתגש	Tun =	5707-16	audoluid:	שכנותו	ال طاعدا	90 36,00	20/1/05	(Priso)	1705/74			t
Snipog Tolui = 18					00110 = T110	Habring =	2 10110	zusvodu	10/02 48	4251P] 4251P]	100119016	205/14	1/120/9	205/14			
; 2.10/0/2/Usunop					7 = 18	28 72/U	עןוחפ					-7//					*!
				 	Σανιιογ	211170											
	<u>, </u>	^			,												:
-1W7-N7-10-10-10-10-10-10-10-10-10-10-10-10-10-	S	I			5	10	no		700	- V6	Z>	<i>u</i>	7	4	5	7	////7-L- A/
FORTRAN STATEMENT	# . ## ###		4	7: (SE SE ET 21 DE	र्गेट इ.स. १४ हिंद	p. 3. 72 11	e ar er ar bi	1. 11 25 15.	FORTRAN S	IVIEWENT	15 68 HP 71 52	15 PS TO 25 15	03 05 85 75 98	· v r .v & . l .	L 0 62 LY 07 V2	37 216 7 31
	11							_1	311		\$601, 505 144	ынсн					

```
LEVEL 18 f SEPT 69 )
                                                         05/360 FORTRAN H
                                                                                                              " " DATE " 71.077/01#55.52"
              COMPILER OFFICES - NAME MAIN.OFF=02.LINECNT=72.SOURCE.FOCDIC.NOLIST.NODFCK.LOAD.MAP.NOEDIT.NOID.NOXREF
DIMENSION TITLE (10)
DIMENSION R(50).Y(50).CM(50).A(50).A(50).CU(50).THTA(50).THTS(50).
      ISN 0002
     15N 0003
                          ITHIP(SO).
                                             OFTA(50)
     15H 0004
                           DIMENSION CUALSO). CS(50). CP(50). CAV(50). RCP(50)
     ISN DOOS
                           KORS
     15N 0005
                           K w=6
     150 0007
                           FCPMAT(7F10.3,F5.2,15)
     154 000B
                         2 FORMAT (4F10.3)
     150 0000
                           READ(KE. 13) TITLE
     ten colo
                           PEACEKY, 1) 91.CU1.CU20.CU2A.TM.Z.O.EN.LMT
     154 0011
                           DEAD(KR. 2) (R(I).Y(I).CM(I).B(I).I=1.LMT)
     114 0012
                           SYCHA=0.
     ISH BOIT
                           DY=n.
     154 001 A
                           HCDAVED.
     154 0015
                           P2=R(LMT)
     154 0016
                           THIS=81*CU1/(R1*CU1-82*CU20)
     1511 0017
                           THAT = 1 .- THIS
     15H 0018
                           DO 100 1=1.LMT
     15N 0019
                           A(1)=9/(Z+P(1)*CM(1))*144.
                           RCUD=N1*CU1*(P2*CU20-R1*CU1)*(1.-(1.-Y(1)**FN)**2)
     154 0020
     15N 0021
                           COULT = DCOCYD (1)
     TEN DOOR
                           18(00(1)) 32,33,32
     154 6023
                       33 RETA(1) = 90.
                           PCP(1) = 0
     154 0024
                           ดก รัก เรื่
     15H 0006
     ACRO MOVA
                       32 TAMBECM(1)/CU(1)
     15H 0027
                           HETA(1)=ATAN(TANR) +57.2958
     ten cosa
                       150 0020
     150 0030
     154 0031
                           RCPAV= (RCP(1)+RCP(1-1))*0.5
     154 0032
                       55 CONTINUE
     Frus Het
                           THIA(1)=57.2958*TM*DY*PCPAV+STORA
     154 CO 34
                           THITS([)=THTA([)-A([)*57.2958/(2.48([))
                           THTP(1)=THTA(1)+A(1)*57.2958/(2.*R(1))
     154 0075
\infty
     15N 0036
                           STORASTHTALL)
     15M 0037
                          CUA( 1)=(TF15+P(1)+CU(1)+THAT+R1+CU1)/P(1)
     15N 0038
                           TF(Y(1))34,35,34
     15N 0039
                       35 1F(FN-1.)36.37.36
     150 2049
                       37 PRTI = 0
     1410 1121
                          60 TO 38
     154 0042
                       34 CONTINUE
                       34 FIRST (P2 * CU2A-RI * CU1) * 2. * FRX (1. - Y(1) * * FR) * Y(1) * * (FN-1.)
38 PFTL = (P2 * CU2A-RI * CU1) * * (1) * * TM*7) * PRTL * (-1.)
CAY(1) = SGRT (M(1) * * 2 + CUA(1) * * 2)
PL TC = PFY CAY(1) * 72 * 174
     154 0043
     154 0044
     154 0045
     15N 9046
                          CS(I)=CAV(I)+DLTC/2.
     TEN MAAT
                          CP(t)=CAV(1)-DLTC/2.
     TEN DOGA
     15N 0049
                      100 CONTINUE
     150 0050
                          WRITE (KW. 11)
     151. 0061
                          WRITE(FW.13) TITLE
     150 0052
                          WRITE (KW. 7)
     ISH DOG T
                          WRITE (KW. 8)
     ISN 0054
                          WRITE (KW. 12) Z.Q.TM.EN
     ISM 0055
                          WRITE (KW. 3)
     154 0056
                          WRITE(KW.4) (R(I).ACI).THTA(I).THTS(I).THTP(I).I=1.LMT)
     150 0057
                          WRITE (KW.F)
     ISN 0058
                          WRITE(KW.6) (Y(1).CU(1).BETA(1).8(1).1=1.LMT)
     154 0059
                          WRITE (KW.S)
     150 0060
                          WRITE(KW, 10) (CUA(I).CM(I).CAV(I).CS(I).CP(I).I=1.LMT)
                       154 0061
    154 0062
    ESN DOSE
    TSN 0064
     TSN 0065
    ISN 0066
                        8 FORMAT (5X. PERADIUS . /5X. A=TANGENTIAL WINTH . /5X. THY MEMFAN WRAP.
                         1./5x, THTS=SUCTION SURFACE WPAP ./5x . THTP=PRESSURE SURFACE WRAP.
                         2/5x, Y=STREAMLINE PASSAGE LENGTH PATIO . /5x, CAV=AVERAGE VELOCITY
    ISN 0067
                        9 FORMAT (/9x. + CUA+ .10x. + CM + .10x. + CAV + .10x. + CS+ .10x . + CP+ ./) ;
```

10 0000 10 FORMATICAX,FX-5,5X,FX-3,5X,

. ೭೦೦ ಎ೦೪ವ

AMLING PASSAG GRAGE VELOCIT BLADES= 11.0
■
2450002

9. AIR PUMP PERFORMANCE MAP

COMPUTER PROGRAM AIR PUMP PERFORMANCE MAP

I. INTRODUCTION

This program generates data for plotting performance maps of pumps or blowers operating in air at low pressure ratios. Inlet condition and performance parameters in normalized form are input. Discharge pressure, temperature rise, torque, overall efficiency and flow rate at the specified speeds and flow parameters are printed out.

This program was written for producing predicted pump performance maps for the NERVA pump air test rig. The use of a digital computer for the calculation of the discharge conditions was necessary to achieve acceptable accuracy at very low pressure ratios ($r_{\rm p}$ <1.2).

II. BASIC EQUATIONS

Performance parameters are obtained from a loss analysis and specified in terms of normalized flow Q/N, normalized head $\rm H/N^2$ and efficiency. Inlet conditions are defined by pressure $\rm p_0$ and temperature $\rm T_0$. Air is treated as an ideal gas.

The air inlet density $\boldsymbol{\rho}_{\boldsymbol{0}}$ can then be calculated as follows:

$$\rho_0 = \frac{144 P_0}{R T_0}$$

R = gas constant = 53.34 ft lb/lb, °F

The isentropic head rise is calculated from input parameters:

$$H = N^2 (H/N^2)$$

and the flow rate in ft^3/s

$$V_2 = N (Q/N)/448.8$$

Pressure Ratio r_p

$$r_{p} = \left(\frac{H + J \left(C_{p}\right) T_{o}}{J \left(C_{p}\right) T_{o}}\right)$$

J = mechanical equivalent of heat (778.26 ft 1b/btu)

 C_p = specific heat = 0.240 btu/lb/°F

Neglecting the discharge velocity head the discharge pressure ${\bf P_2}$ is:

$$P_2 = r_p P_0$$

Temperature rise ΔT

$$\Delta T = \frac{T_o(r_p)}{\eta} - \frac{K-1}{\kappa}$$

 η = pump efficiency (input)

thus:

$$T_2 = T_0 + \Delta T$$

and

$$\rho_2 = \frac{144 P_2}{R T_2}$$

Torque M_t in In. Lb.

$$M_{t} = 12 \frac{V_{2} \rho_{2} H}{\eta \omega}$$

$$\omega = \frac{II N}{30}$$

NOMENCLATURE

INPUT PARAMETERS

SYMBOL	DESCRIPTION		UNITS	FORMAT
XN(1)-(5)	Rotational Speed		rpm	F
NUMQ	Number of specified points (Q/N)	÷	5.4	15
NUMN	Number of Speeds		2-	15
Т0	Inlet Temperature		Deg R	F
PO	Inlet Pressure		psia	F
QN(J)	Flow Parameter		gpm/rpm	F
HN(J)	Normalized Isentropic Head		ft/rpm ²	F
ETA(J)	Efficiency		. .	F

(67 NH 11 11 : | | | BONESHIDES BEDELL DIVINGE IS FORTRAN STATEMENT MASTRICTIONS MARCHING AIR PUMP PERFORMANCE MAP 30Vd CRAPHIC A.S.U of benefit

```
TIN FOR MAIN
                                                                                   10 APR 72 12:04:31.789
   FORTRAN V: ISD VERSION 2.2
   THIS COMPILATION WAS DONE ON 10 APR 72 AT 12:04:31
     MAIN PROGRAM
     STORAGE USED (BLOCK, NAME, LENGTH)
           0001
                  *CODE
                          000277
           0000
                  *DATA
                         000441
           0002
                  *BLANK COUCOO
     EXTERNAL REFERENCES (BLOCK: NAME)
           0003
                 RROUS
           0004
                 NIG25
           0005
                 NI013
           0005
                 NADUE
           0007
                 NEXP65
           0010
                 NSTOP5
     STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)
                              0000 000330 100F
                                                      0000 000337 102F
                                                                             0000 000363 104F 0000 000407 106F 0001 000141 1726 0000 000240 20F
      0000 000233 10F
                              0000 000235 15F
                                                           000113 161G
      6001
           000046 1336
                                                      0001
                                    000251 2256
                                                            000242 25F
                                                                                   000246 30F
                                                                                                     0000 000255 32F
      0001
            000023 200L
                              0001
                                                      0000
                                                                              0000
                                                                             0001 000273 900L 0000 R 000113 DP
0000 R 000043 H 0000 R 00012 HN
            000310 34F 0001 000122 40L
                                                      0001 000004 500L ·
      0000
      0000 R 000175 DT
                              0000 R 000125 DTI
                                                      0000 R 000024 ETA
                                                     0000 I 000221 LR
0000 R 000226 PO
      1 SERMOD I CUCO
                              0000 I 000227 J
                                                                              0000 I 000222 LW
                                                                                                     0000 I 000224 NUMN
                        0000 1 000227 J
0000 R 000067 PR
                                                                                                0000 R 000000 ON
      0000 I 000223 NUMO
                                                                              0000 R 000101 P2
      0000 R 000231 RHC
                              0000 R 000151 RH02
                                                      TMT 705000 R 0000
                                                                              0000 R 000225 TO
                                                                                                    0000 R 000137 T2
                              0000 R 000163 V0
                                                                              0000 R 000036 XN
      0000 R 000230 VO
                                                      0000 R 000055 V2
   00101
                      DIMENSION GN(10), HN(10), ETA(10), XN(5), H(10), V2(10), PR(10), P2(10),
                     1DP(10),DTI(10),T2(10),RH02(10),V0(10),DT(10),TMT(10)
  00101
   30103
                      LR=5
            3*
   00104
                     1LW=6
                    10 FORMAT(*1*)
  00106
                  - 15 FORMAT(215,F10.1,2F10.3)
                    20 FORMAT(5F10.1)
   00137
   60110
                   25 FORMAT(F10.3,E10.3,F10.3)
            8*
   00111
          --- O# ··
                500 READ(LR,20) XN(1),XN(2),XN(3),XN(4),XN(5)
                      IF(XN(1)) 900,900,200
   00123
           10*
   00123
           11*
                  200 READ(LR:15) NUMO:NUMN:TO:PO
                      READ(LR.25) (GM(J), HM(J), ETA(J); J=1, NUMQ)
  00131
           12*
   00141
           13*
                      VO = 0.370416 * TO/PO
                      Rh0 = 1./V0
  00142
           14*
                    30 FORMAT(30X) AIR TEST PUMP PERFORMANCE MAP //)
 - 00143
           15+
                    32 FORMAT (2X, INLET TEMPERATURE TO = 1, F7.2, 2X, 'DEG F1, 10X, INLET PRE
  00144
           10*
                 ISSURE PO = ', F8.3,2X' PSIA'//2X,'INLET WEIGHT DENSITY RHO =', F8.5,2
2X,'LB/FT**3'//)
           17+
   00194
-- 00144
           155*
                    34 FORMAT (10X, PUMP CHARACTERISTICS*//6X, 0/N*, 7X, ETA*, 10X, H/N**2*
   00145
```

```
END OF UNIVAC 1108 FORTRAN V COMPLLATION.
            0 *DIVENOZLIC* WESSVEE(S)
                                                                                        95200
                                                                    EVD
                                                                                 *25
                                                                                +19
                                                                                        99200
                                                                   d015 006 . ...
                                                  01/009/00S (I-NKON) dI
                                                                                 *09
                                                                                        24700
                                                                                 *65
                                                                                        00052
                                                   1(0), TKT(0), 1=0, (U) TKT, (U)
                                                                                        00523
   האודב(נייונה) (מא(ט) יעצ(ט) יאנט) ואפרט יפארעט (ט) יפארעט (ט) יפארעט (ט) יעצר ארט (ט) ישר ארט (ט) ישר ארט (ט) י
                                                          MBILE(FM+IO#)
                                                                                 *15
                                                                                        COEST
                                                                                 *95
                                                                                        21200
                                                          ASILE(FA:10S)
                                                    MBILE(FM+T00) XM(I)
                                                                                        tilino.
                                                                                        20872
       106 F08%AT (2F10.3*F11.3*F9.4*F12.4*F11.3*F10.3*F12.5*F10.3*F10.3*F10.3)
                                    18\EL**2:\tX\:EL**2\S:\2X\:INFB:\\)
                                                                                 *55
                                                                                        21200
   104 FORMAT (16X) FT/S',6X, FT',18X, PSIA', XY, IN H20',6X, DE6 F',4X,'L
                                                                                *2h
                                                                                        00515
                                        ('EU080T',X3.'0V',X8.'SORF',XYI
                                                                                        11700
                                                                                        11000
   TOS ECOBWYI (2X1:0\M:\6X\:AX:\LX:\DH:\8X\:BB:\6X\:AX:\TOX\.DB:\6X\:DI:\
                                                                                 *01
  20* .... 100 BORWAT (////SX:*SBEED =::EX:I:* RPM://)
                                                                                        01700
                                           60 \text{ VO(J)} = \text{V2(J)} * \text{RHO2(J)/RHO}
                                                                                ୍ୟଞ୍ଚ
                                                                                        90700
                                                                                 *45
                                                                                        0.0502
                 IMI(0) = ITM \cdot 281 * H(0) * AS(0) * BHOS(0) \EIV(0) \XX(1)
       ... UHOS(1) = 1./(0.370416 * T2(J)/P2(J))
                                                                                        0050tt
                                                                                        00500
                                                     (C) TC + DT = (C) ST
                                                                                 *+0
                                                                                        00505
                                                  (U)ATBV(U)IIG = (U)IG
01 - 585.0**((U)99)*01 = (U)110
                                                                         *55
                                                                                        T0700
                                                                                        00700
                                             CP(U) = (P2(U) - P0) * 27.67
                                                                                 *56
                                                                                 *17
                                                     P2(J) = PR(J) * P0
                                                                                        ZZT08
            PR(U) ± (UH) + 186.768*T0)/(01*867.881 + (U)H)) ± (U)R9
                                                                                        94100 .....
                                                                                 *02
                                             \Delta S(0) = XII(I)*ON(0) \land IIIX = IO) \land A
                                                                                 *67
                                                                                        92100
                                                H(1) = HA(1) \times XA(1) \times S
                                                                                 *83
                                                                                        00114
                                              DO POLNETINOMO
                                                                                .*LZ.
                                                                                        TZT00...
                                                                                        04100
                                                                                 *97
                                                              I + I = I 0t
                                                                  0 = I
                                                                                 *97
                                                                                        Z9T00
                          WRITE(LW.34) (ON(J), ETA(J), HN(J), J=1, NUMA)
                                                                                 *52
                                                                                       MBILE(FM'25) 10'80'8HO
                                                                                 *22
                                                                                        COTES
                                                           WRITE(LW+30)
                                                                                        09100
                                                                                 $22
                                                          MMILE(FM:70)
                                                                                 *17
                                                                                        95700
                                                T//(ET0.3,F10.3,E14.3))
```

AIR TEST PUMP PERFORMANCE MAP

" INLET	TEMPERATURE TO = 530.	00 DEG	F .	INLET PR	ESSURE PO	= 14.500	PSIA
INLET	WEIGHT DENSITY RHO =	.07386	LB/FT**3				

PUMP	CHI	ARA	CTFF	RIST	TCS

g/N	ETA	H/**2				
•05∪	.290	.845-04				
.100	495	.840-04	The second secon	•		
.150	.615	800-04			•	
.200	.675	.730-04	The second of th			Andrews Control of the Control of th
220	.630	.694-04				
.250	•67U	.649-04				
.300	.632	.540-04	and the same of th		 	
. 350	•551	.430-04	,			
.460	.410	·295-04			•	
.450	.140	.850-05		and the second s	 	

SPEEU = 5000.0 RPM

0/10	V2 FT/S	DH	PR	P2 PSIA	DP IN HÀO	DT DEG F	RH02 LB/FT**3	V0 FT**3/S	TOROUE
.050 .100 .150 .200 .220 .250 .300 .350 .400	.557 1.114 1.671 2.228 2.451 2.785 3.342 3.899 4.456 5.013	2112.500 2100.000 2000.000 1825.000 1735.000 1600.000 1350.000 1075.000 737.500 212.500	1.0775 1.0770 1.0732 1.0667 1.0633 1.0583 1.0490 1.0389 1.0266 1.0076	15.6233 15.6165 15.5620 15.4669 15.4182 15.3453 15.2109 15.0641 14.0853 14.6103		39.002 22.714 17.412 14.476 13.661 12.786 11.437 10.446 9.631 8.127	.07413 .07628 .07675 .07669 .07656 .07632 .07584 .07525 .07447	.559 1.150 1.736 2.313 2.541 2.878 3.432 3.972 4.493 4.975	6.893 8.262 9.558 10.587 10.972 11.633 12.808 13.118 13.679 12.781

SPEED = 6000.0 RPM

0 Δ 11	V2 FT/S	DH FT	PR	P2 PSIA	IN H50	DEG F	RH02 LB/FT**3	V0 FT**3/S	TORQUE INLB	
-050	•668	3042.000	1.1129	16.1368	45.290	56.163	•07432	•673	9.952	129-

g garage g	sa. 211	3.50	·		- A	Ville elle ole 1840	Santon om Males Milita	20 300 a. 425 a.	La la maria de la constante de	and the second of the second
<u> Karantan kanada ka</u>		7000 000	1 1122	10.12.5	ALC: DO	70				and the second s
• • • •	1.337	3024.000	1.1122	16.1267	45.012	32.709	.07737	1.400	12.067	
.150	2.005	2880.000	1.1067	16.0464	42.790	25.073	•07804	2.119	13.996	
.200	2.674	2628.000	1.0970	15.9066	38.921	20.845	•07796	2.822	15.498	
.220	2.941	2498.400	1.0921	15.8351	36.941	19.672	•07777	3.097	16.049	
.250	3.342	2304.000	1.0847	15.7281	33.982	18.412	.07742	3.503	16.993	
.300	4.010	1944.000	1.0711	15.5315	28.542	16.469	•07673.	4.166	18.076	•
•350	4.679	1548.000_	1.0564	15.3172	22,613	15.042	•07587	4.806	19.046	
•400	5.347	1062.000	1.0384	15.0572	15.418	13.868	•07474	5.411	19,770	•
•450	6.916	306.000	1.0110	14.6590	4.400	11.703	•07306	5.950	18.345	
							• •			- March 1 (1) - P (1) P (1) -
SPEED = 701	00.0 RPM		•							
3/N	. V2	DH	PR	P2	DP.	DT	RH02	Vo	TORQUE	ACCORDING ON THE CONTRACT OF T
37.1	FT/S	FT	ΓK	PSIA	IN HSO	DEG F	LR/FT**3	FT**3/S		
					IN 1180	OCO P		F (**3/3	INCO.	
•050	.780	4140.500	1.1558	16.7591	62.510	76.444	.07461	•788	13.597	
.100	1.560	~ 4115.000								
			1.1548	16.7451	62.121	44.520	•07868	1.662	16.704	
.150 .200	2.339 3.119	3920.000	1.1471	16.6328	59.016	34.127	•07960	2.521	19.429	
		3577.000	1.1336	16.4378	53.618	28.373	• 97947	3.356	21.504	
.220	3.431	~~340U.600	1.1268	15.3381	50.860	26.775	.07922	3 • 680	22.251	
.250 .300	3.859	3136.000	1.1165	16.1894	46.746.	25.060	.07874	4.157	23.523	•
.350	4.679	2646.000	1.0977	15.9166	39.197	22.416	•07778	4.928	24.943	
.400	5.459	2107.000	1.0773	15.6203	30.999	20.474	•07661	5.662	26.176	
.450	6.238 7.018	1445.500 416.500	1.0526 1.0149	15.2621 14.7167	21.088 5.997	18.877 15.928	•07507 •07278	6.341 6.915	27.027 24.874	
And the passes of the later same								. 000,200		
and the same of th									· · · · · · · · · · · · · · · · · · ·	
SPEED = 800	00.0 RPM				•					
				777 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -					TO SECUL	A CONTRACTOR OF
@ / (3	٧2	DH	PR	P2	DP	DT	RHO2	٧o	TOROUE	
	*** FT/S **	FT		PSIA	IN HZO	DEG F	L9/FT**3	FT**3/S	INLB	and annual for the control of the co
			,		•				,	
.050	891	5408.000	1.2068	17.4984	82.964	99.845	•07500	•905	17.854	
.100	1.782	5376.000	1.2055	17.4794	82.440	58 • 149	.08023	1.936	22.246	
.150	2.674	5120.000	1.1951	17.3284	78.261	44.574	.08142	2.947	25.957	+
	3 .565	- 4672.000-	1.1770	17.0663	71.010	37.058	.08125	3.922	28.715	
.220	3.921	4441.600	1.1678	16.9327	67.312	34.972	•08091	4.296	29.684	
.250	4.456	40.96.000	1.1540	16.7336	61.803	32.732	•08928	4.843	31.324	
	5.347		-1.1289	16.3694	51.725	29.278	•07902	5.721	33.004	
.350	6.238	2752.000	1.1017	15.9753	40.822	26.741	.07747	6.543	34.572	
.400	7.130	1838.000	1.0690	15.5011	27.700	24 • 655	•07545	7.283	35.480	

_

10. PUMP AXIAL THRUST PREDICTION PROGRAM

PUMP AXIAL THRUST PREDICTION PROGRAM

1. INTRODUCTION

- a. The program was developed to predict the flow distribution and rotor axial thrust of the NERVA Turbopump. The variation in the parameters are also Monte Carlo'ed.
- b. The program listing and narrative along with an input list and rotor schematic are included.
- c. The program was debugged and modelled the "C" change turbopump.
- d. Changes to engine operating conditions can grossly effect the internal flow within the turbopump.
- e. No related activities.
- f. This program was developed by R. A. Livingston.

2. CONCLUSIONS

- a. Gross Conclusion
 - (1) The program appeared to represent the actual turbopump quite accurately.
 - (2) The program, analytically, performed all of its required functions.
 - (3) The next logical modification would be the inclusion of subroutines to determine influence coefficients.

b. Interpretation

- (1) The program does not derive conclusion, i.e., values only.
- (2) The accuracy of the analysis has great implication relative to thrust balancer performance .
- (3) The accurate representation of the correct thermodynamic properties and processes have significant implication as to the validity of the results.

3. RECOMMENDATIONS

- a. The program can allow determination of optimum clearance and yet maintain the desired reliability within the turbopump.
- b. No problems have arisen as a result of this work.
- c. The analytical prediction need, next, to be compared to actual test data.
- d. See b.(3) under conclusions.

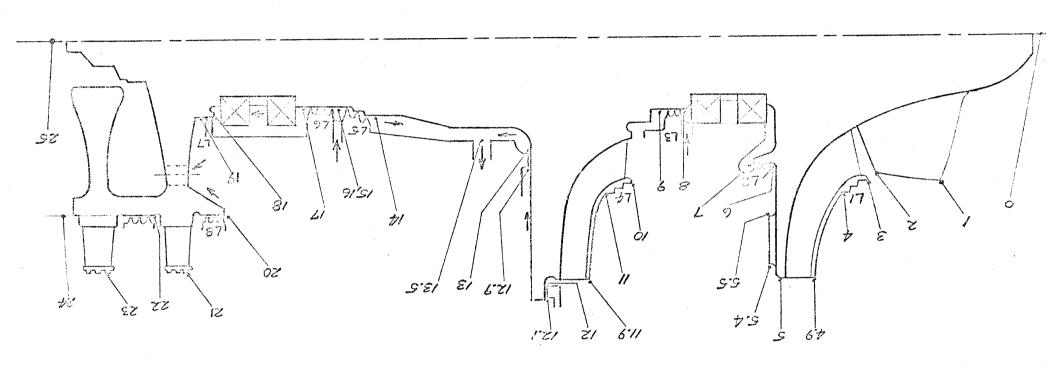
4. REFERENCES

None

I. INTRODUCTION

A mathematical model of the NERVA turbopump internal flow network was developed to permit both statistical and single point (i.e., data set) evaluation of the pump internal flows and balance piston position. The primary dependent parameters are the hydrostatic thrust balancer position in the housing and the flowrates thru the several labyrinth seals and flow circuits which include the bearing coolant and thrust balancer flow circuits. These "output" parameters are computed for each set of "input" parameters which consists of the pump component dimensions, various factors such as the rate of fluid to rotor angular velocity, and the pump operating conditions which include interface pressures, shaft speed and propellant conditions, see Table 1. For a single point computation, the mean values of the input parameters are used to compute a corresponding set of mean output parameters. For statistical analysis, the input data consists of the set of mean values of the input parameters plus a corresponding set of variances, one for each input parameter. The math model is programmed to execute any desired number of repetative solutions of the output versus input parameters, each computation using a different set in input parameters as governed by the input variances and a random distribution within any specified). The program output for a statistical distribution characteristic (Figure analysis (Monte Carlo) case consists of the mean, standard deviation and range of each computed parameter. Since all the input parameters are not independent there are correlation equations to approximate the relationship of interacting parameters. In the current version of the program, the turbine inlet pressure variation is a function of the pump discharge pressure variation, and interstage turbine pressures are maintained in constant ratio. In a real pump, there exists a relationship between pump discharge pressure, flowrate and shaft speed. this model of the turbopump they are left independent because of the relatively weak effect of shaft speed and flowrate on the output parameters as compared to pressure distribution factors and because an accurate accounting of the relationship between speed, flow, pressure and turbine flowrate would require an overall system analysis which would exceed the scope of this project. A future goal for improving this model might include the development of an influence coefficient

method predicting the interaction of these parameters. Figure 1 is a schematic of the turbopump rotor with the stations numbered for reference in the program . equations and parameter list (Reference Table 1 and the program listing).



LOG VXIBL THRUST ANALYSIS
TPA 1118101-C , ROTOR SCHEMATIC

TABLE 1 PARAMETER LIST

INPUT	PARAMETERS	
NO.	CODE NAME	
1	PPD	Pump Discharge Pressure (at flange), psia
2	P1F	Pump 1st Stage Pressure Rise Factor = P(10)/PPD
3	PS	Suction Pressure at Inducer Inlet (0), psi
4	PIF	Inducer Discharge Pressure (2) Factor P(2)/PPD
5	PTI	Turbine Manifold Inlet Pressure, psia
6	PTE	Turbine Exhaust Pressure P(24), psia
7	TTBP	Balance Piston Total Travel (O Clearance to Clearance), in.
8	WPD	Pump Discharge Flowrate, 1b/sec
9	RPM	Pump Shaft Speed, RPM
10	P5F	Pressure P(5) Factor = P(5)/PD1
11	P12F	Pressure P(12) Factor = P(12)/(PPD-PD1)
12	TBPR	Turbine Bypass Ratio = (WPD - w(Turb))/WPD
13	P21	Static Pressure at Sta. (21)
14	P22	(22)
15	P23	(23)
16	P24	(24)
17	TS	Temperature of Hydrogen in Suction Line
18	TPD	Temperature of Hydrogen at Pump Discharge
19	AT1	Flow Area thru Impeller No. 1 Turn, in 2
20	AT2	Flow Area thru Impeller No. 2 turn, in ²
21	RHOTI	Turbine Inlet Gas Density, 1b/in ³
22	THOTE	Turbine Discharge gas Density, 1b/in ³
23	CL1	Labyrinth Seal No. 1 Flow Coefficient = $\rho \Delta P/\dot{w}^2$
24	CL2	No. 2
25	CL3	No. 3
26	CL4	No. 4
27	CL5	No. 5
28	CL6	No. 6
29	CL7	No. 7
30	CL8	No. 8
31	RTEH	Resistance of Holes thru Turbine Discharge = $\rho\Delta P/\dot{w}^2$
. 32	RBPR	Resistance of Balance Piston Return Flow Circuit = $\rho \Delta P/\dot{w}^2$
33	RTBS	Resistance of Turbine Bearing Supply Circuit $=\rho\Delta P/w^2$
34	RPBS	Resistance of Pump Bearing Supply Circuit

TABLE 1 (Continued)

NO.	CODE NAME	
35	YBV1	Inner Radius of Back Vanes (Sta. 5.5)
36	YBV2	Outer Radius of Back Vanes (Sta. 5.4)
37	XK4	Fluid-Rotor Angular Velocity Ratio, Sta. 4-4.9
38	XK5	5-5.4
39	XK55	5.5-6
40	XK7	7–8
41	XK11	11-11.9
42	XK12	12-12.1
43	XK121	12.1-12.9
44	XK129	12,9-13
45	XK13	13–14
46	XK17	17–18
47	XK19	19–20
48	XKBV	5.4-5.5
49	Z0	Static Pressure Profile Factor (= .5 for Linear Dist.) Sta. 0-1
50	Z3	3–4
51	76	6-7
52	Z8	8-9
53	Z10	10-11
54	Z14	14-15
55	Z16	16-17
56	YO	Line Radius at Sta. 0
57	YIH	Inducer Hub Diameter at Blade L.E.
58	¥1	Radius at Station No. 1
59	Y2	No. 2
60	Y3	No. 3
61	Y4	No. 4
62	Y5	No. 5
63	Y6	No. 6
64	Y7	No. 7
65	Y8	No. 8
66	Y9	No. 9
67	Y10	No. 10
68	Y11	No. 11
69	Y12	No. 12
70	Y121	No. 12.1

TABLE 1 (Continued)

NO.	CODE NAME	
71	Y129	Radius at Station No. 12.9
72	Y13	No. 13
73	Y135	No. 13-5
74	Y14	No. 14
75	Y15	No. 15
76	Y16	No. 16
77	Y17	No. 17
78	Y18	No. 18
79	Y20	No. 20
80	Y21	No. 21
81	Y22	No. 22
82	Y23	No. 23
83	CD12	Balance Piston Orifice Discharge Coefficient Sta. 12
84	CD13	Balance Piston Orifice Discharge Coefficient Sta. 13
85	P5G	Pressure Gradient Between Stations 4.9 & 5 (+ if P5 > P4.9) psi
86	P12G	Pressure Gradient Between Stations 11.9 & 12 (+if P12 > P11.9) psi

OUTPUT PARAMETERS (COMPUTED)

NO.	CODE NAME		
1	T	Thrust Balancer Inner Orifice Land Clearance, In.	rust Balancer Inner Orifice Land Clearance, In.
2	CFBP	Balance Piston Load (Sta. 12-13), 1b.	lance Piston Load (Sta. 12-13), 1b.
3	SBP	Balance Piston Axial Stiffness, 1b/in at T	lance Piston Axial Stiffness, 1b/in at T
4	P1	Pressure at Station 1	essure at Station 1
5	P4	4	4
6	P5	5	5
7	P54	5.4	5.4
8	P55	5.5	5.5
9	P6	6	6
10	P7	7	7
11	P8	8	8
12	P11	11	11
13	P12	12	12
14	P121	12.1	12.1
15	P129	12.9	12.9
16	P13	13	13
1.7	P135	13.5	.13,5
18	P14	14	14

TABLE 1 (Continued)

	•	
NO.	CODE NAME	
19	P15	Pressure at Station 15
20	P16	16
21	P17	17
22	P18	18
23	P19	19
24	P20	√ 20
25	WL1	Flowrate thru Labyrinth Seal No. 1, 1b/sec
26	W7	No. 2
27	W8	No. 3
28	WL4	No. 4
29	WL5	No. 5
30	WL6	No. 6
31	WL8	No. 8
32	WPBS	Flowrate thru Pump Bearing Supply Circuit, 1b/sec
33	WBPR	Flowrate thru Balance Piston Return Circuit, 1b/sec
34	WBP	Flowrate thru Balance Piston, 1b/sec
35	WTBS	Flowrate thru Turbine Bearing Supply Circuit, 1b/sec
36	WTEH	Flowrate thru the Turbine Disc Vent Holes, 1b/sec
37	F011	Summation of Axial Forces between Stations 0-11
38	F1325	→ → → → → → → 13–25
39	FTURB	Summation of Axial Forces Acting on Turbine Blading
40	FM1	Fluid Turning Reaction thru Impeller No. 1
41	FM2	No. 2
42	FMOM	FM1 + FM2
43	F0	Pressure Force Between Stations 0-1, psia
44	F1	1-2
45	F2	2-3
46	F3	3-4
47	F4	4-4.9
48	F5	5-5.4
49	FBV	5.4-5.5
50	F55	5.5-6
51	F6	6-7
52	F7	7-8
53	F8	8–9
54	F9	9-10

TABLE 1 (Continued)

<u>NO.</u>	CODE NAME	
55	F10	Pressure Force Between Stations 10-11, psia
56	F11	11-12
57	F13	13–14
58	F14	14–15
59	F15	15-16
60	F16	1617
61	F17	17–18
62	F19	19-20
63	F25	24–25
64	RH00	Fluid Density at Station 0, 1b/in ³
65	RH05	5
66	RH06	6
67	RH07	7
68	RH012	12
69	RHOPD	Pump Discharge
70	R0129	12.9
71	R0135	13.5
72	RH018	18
73	P49	Pressure at Station 4.9, psia
74	P119	Pressure at Station 11.9, psia

a motherwaters much of the move that your internal flow notwork was I've but to grant. South statistical and single good (se tate set) evaluation gitten pention of the george internal flower and balance. The grinning. dependent perantiers are the hydrotate thrust balance position in the housing and the powertes thru the several legistic seals and flow circuits which industs the Koring colout and thrust belower for anut. Thee sugar parameters are conjust for each set of imput" parenters, which somits of The gung arregard divisions, various forther much as the natural fluid to not an anyther wheely, it and The pump operating conditions which wilness with re-

of the men standard devictor and roung of such companies output for a statistical southing (motocold) and consisting majured the . (- impl) standards within the purposes injust warmers and as much a distribution within only. a style ach in impak powerters, as ground by the the wife of warmer property promotes as sent compression serving to south any desired number of represent solutions of for soil supert presenced. The moth moth is programmed under parameters plas a consopration sof of worderess, one the import data country of the not of man relieur of the set of men output parameter. De statisted anolysis Jugardine - sulm & som or - wife which failer de single pirt augustition, the man salues of the sit with much and quiplimet and their, amount

parameter. Since all the input parameters are not subgrabled, There are correlation equations to appropriate the relativistic of interacting parameters. On the consent servin of the program, the tenture inlet pressure is a function of the pump decharge guessee variation, and interstage tentre premues are maintained in contact ratio, the a real pump, There exists a relationship between pump descharge grunner, Sometic and shift greed. In Alex model of the turkgroup They are life integralist become gothe attack affect. of short speed and flowered on the outget parameters as compared to jumper I and because an accurate occurating of The relationship between speed office, pressure and turbine flower would require as correctly often energy which would exceed The very of this grayet. It fitting good for improving

Signed with predicting the intersection of these parameters.

Jugare 1 is a schematic of the turbopump rotor

with the stations numbered for reference in the program

gravium and parameter list (reference table 1 and the

grayan listing)

Reference List

INPUT PHAMERYS

	green destance previous (at lange), PSIA	grown 1st wing messere sine forther = P(10)/PPD	necess mount of underson with (0) ps.	Induced descharge pressure (2) factor P(2) /PPD	tradent manfield what pressure 181A	Finding soldered yearing P(24) PSIA	Johnson girten telal Frank (O decisare to o dearance) in	gray district floored, Klace	party shift about River	100/()/(PPI) -	Ferdinic Lypsia patrio = (WPD-W(MRB)) /WPD	side grown at six. (21)		(23)		Long of land of havings in medicon line	" " at yeary declare	for and they my the ro. 1 - there, in		to Lough, Whis.	" dustry " "	
10 10 10 10 10 10 10 10 10 10 10 10 10 1	000	<u>ii</u>	197	PIF	ILO	DTC TILL	TTEP	MPD MPD	Robert	PSF	PIZE	780R	P21	776		7.	√3 	TPD	1-17	177	RHATT	RHATE	
		₩.	\$ - \$	<i>/</i>		O	0	O/3	Gran		A Section 1	15	2	2	A STATE OF THE STA					9 2			

7.37.0 V.	\$\frac{\rho\phi\lambda\phi}{\rho\phi\lambda\phi\rho\phi\lambda\phi\rho	
	CTUR (=,5 FOR LUNEAR	
	note of the first	
10 2 CT 2 C	KREEL NOW AND WARES NOW AND WARES NOW AND WARES XKK7 XKK7 XKK7 XKK7 XKK7 XKK7 XKK7 XKK	
22 22 22 22 22 22 22 22 22 22 22 22 22		

31	See S	
9 5		Liebron flat derita de las Lies
\$\$		Radicio at station par 1.
5 45 C		2
3	•	
1 ~ 2		
654		
	;	
99)	- 1	
67	:	
	:	
72		
23		
77		(1)
82		
7		
28		
70		
J 60		Palance Brother Order
8		1 State 13
\(\sqrt{\infty} \)		mound gradient between stations 49 45 (+4 PS>PAG)
5,3	1	(10) (
	1	

	the section of the se																								2	Ŋ		Ç
	has Land elected	11 12 11 11 11 11 11 11 11 11 11 11 11 1																						and mad no				
	a house con		Marie 16	#	V	5.6	16	3	7	∞0	• 1	12,		169	13	(3)						14	200	Salar Sa				
	trout hateres		morning of 1	· :																			**************************************	Levell L				
Cost Cost	ا د د	1 2 2 c. 1	<u>o</u>	, ()	by and a second	psd	200 N	2	1.d	00	ll d	PIZ	P12.1	P129	613	PIBS	DIG	SI	0.16			5-2	Pzo	WLI	W 7	W.S	MICH	6:12
	√ €	j J,	J.	*****	9	\	Jo.	ij ~ ,	***	#	2/	13	14	/5/	9/	17	3/	12	2	Č(2	277		25	500	77	<i>Q</i>	(v

WLS WESE WESE WIES

7 2 2 2 2 2

·			
-	100	URING	
	√) 1-3	The state of	Leavente Three the Teachers done don't were the face.
	ĝ.	F011	General Box of April Long Linear District 0-11
	``&		
	ta i	24014	: `
	<u>ت</u> د	Santi.	The start of the s
	0.7	10 80 A	
	1.37	2 844	7.
	25	5 5 5 6	
			PSIA
	<u></u>		
		1	
1 1 1 1 2 2 2 3 1	S. C.	7	2~3
:	7.3	(~) <u>i</u>	3.4
	10	77	7.49
	1.5	\ \(\frac{1}{2} \)	75.5
	3) - (
	3	F87	
		755	5,576
	Man and	9 발	
	2.5	E	8.72
	; · (\)	Со Ц	
	Ty.	<u>.</u> L	$\alpha l \sim l$
	\$5	<u>C</u>	
	25		11-12
	67		
	in the	13- 12.1	$\mathcal{M}_{m-1}S$
	6		
	<	<u>5</u>	16-17
	19	FIT	I_{2}
	29		19-20
	# •///	(A)	
	75.57	0 \$HX	had down at store on the state of
	Ğ		
			9
	: }	1 2 3	
		PHG 12	
	3	Q4 2 1/3	Therefore it is the second
		The second	

()

M. Comp.	\$ 50 E	
3.5	23	
fleed divining at maken 13.5		1111
Land of the A	Regional States	
discol "		
Co. 6. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	1245/5 1049 10119	
N3.	4 6	

.

D9 RUN LVGSTN.428206.1.100		15 MAR 72 13:19:46.457
(LISTING)		
COMPUTER PROGRAM FOR		
PUMP ROTOR AXIAL FORCE BALANCE		4
INCL. MINNIE-CARLO ANALYSIS OF BALANCE		
PISTON POSITION VS. SYSTEM VARINBLES		
e egiste e en en egiste de la estada en en entre en		
		r
	<u> </u>	
•		

		· ·							
DIR FOR TLUZ	o versión 2.1				MAR 72	13:19:46.517		<u> </u>	
THIS COMPILATION	OH WAS DONE OH 15 MAR	72 AT 13:19:46	*		•			•	
SUBROUTINE 1		<i>i</i>							
	O (BLOCK . NAME . LENGT	H)							
	*DATA 000007								
0002	#BEVNK 000000	•							·
EXTERNAL REF	FERENCES (BLOCK, NAME	:)			4			,	
0003	NERROW							ļ	
STORAGE ASS	IGNMENT FOR VARIABLES	G (BLOCK, TYPE, R	RELATIVE LOCATION.	NAME)					
A second							•		
							,		
	a power currentt	INE EOD HO DENSTI	THE PARTY AC A CURIC						
00100 2+	C (UARG) ARD TER SUBROUTTHE TEL	SP. (MARC)	TY (ZARG) AS A FUNC HIV:UARG:VARG:ŽARG:						
	C DIARGA ARD THE	SP. (MARC)	HV.UARG.VARG.ZARG.			ı			
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TEN SUBROUTINE THE ZARGE.0025 RETURN	P. (VARC) S (HDH+U+V+Z+HU	HV,UARG,VARG,ZARG,	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	O *DIAGMOSTIC* M	(GNI					
00100 25 00101 35 00103 6* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	HV,UARG,VARG,ZARG,	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	O *DIAGMOSTIC* M	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	O *DIAGMOSTIC* M	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	O *DIAGMOSTIC* M	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END	P. (VARC) S (HDH+U+V+Z+HU	O *DIAGMOSTIC* M	(GNI					
00100 25 00101 35 00103 4* 00104 5* 00105 6*	C (UARG) AND TENDEROUTTHE TELE ZARG=.0025 RETURN END		O *DIAGMOSTIC* M	(GNI					

©I FOR N FORTRAD	v: ISD V	EKSION 2	•1 %			·	to w	AR 72 13	Tathy hara			
THIS CO	PILATION	WAS/ DONE	ON 15 MAR	72 AT 13:19	9 : 47	· •						•
		/				:		•				
FUNCI	TION NORT	/	HTRY POINT	000134	1						•	
STORA	IGL USED (BLOCK . N	AME: LENGT	11)								
			00160 00046						٧			
		BLANK C				-						
				<u> </u>				4	<u> </u>	*	<u>·</u>	
ехтер	RNAL REFE	RELICES (I	LOCK. NAME) .·							<i>i</i>	
	6003	VERROS								1		
							· · · · · · · · · · · · · · · · · · ·					
STOR	AGE ASSIG	NMEHT FO	R VARIABLES	(BLOCK, TY	PE, RELATIVE	LOCATION: NAME)	,	, ,				
000	1 00003 1 00006 0 1 00000	6 7L	0001	000061 11L 000057 9L 010001 J	0000	000050 1166 P 000003 BARG R 000000 NORM	0001 00 0000 R 00 0000 R 00	0005 CARG		000006 R 000006		
	THIS SO	BREUTING	Сомрите:	S THE INPUT	- PARAMETER	VACUES FROM	n MPUT MEA	U (AM) É	STD. Dev.	WITH PANE	XII NORM	AL D
						VACUES FROM	n paput pieA	U (AM) É	STD. D.W.	WITH RANG	EM NORM	AC D
00101 00103 00104	1* 24	FUNC REAL	CTION HORM - HORM HOSTON BUIS	(AM,S,IX,R,		VALUES FROM	n psput plea	U (AM) É	STD. DEV.	WITH PANE	en Norm	AL D
00101 00103 00104 00105	1* 24 5* 4*	FUNC REAL () 171 U=1:	TION HORM . HORM .HSTON B(15 (*262147	(AM,S,IX,R,	c)			N (AM) É	STD. DEV.	WITH PANE	XII NORII	AC D
00101 00103 00104 00105 00106	1* 24 5* 4*	FUNC REAL DICE J=1: IF G IC* THE	TION HORM . HORM .HSTON B(15 (*262147	(AM,S,IX,R,	c)	VACHES FROM		N (AM) É	STD. DEV.	WITH RANG	XIII NORII	AC D
90101 09103 00109 80105 00106 00111 00111	1.* 2.4 3.+ 4.+ 5.4 *DIAGNOST 6.* 7.*	FUNG REAL (517) J=1: IF (- 10* THE 1 J=J 2 U=J	TION HORM - HORM HEJON B(15 (*262147)) 1.2.2 THUICATED +3435973836	(AM,S,IX,R, 3),C(15) ARITHMETIC 57+1	c)			N (AM) É	STP. DEV.	WITH RANG	en Norm	AL D
00101 00103 00104 00105 00106 00111 00111 00112	1* 2* 4* 5* 4* *DIAGNOST	FUM REAL (517) J=1: IF (- 10* THE 1 J=J 2 U=J	CTION (10RM - 110RM - 115EON B(18 (*262147 J) 1.2.2 THEICAYED +3435973836 5=U/3435973	(AM,S,IX,R, 3),C(15) ARITHMETIC 57+1	c)			U (AM) É	STD. DEV.	WITH RANG	en Norm	AL D
00101 00103 00104 00105 00105 00111 00111 00112 00112 00114 00115	1* 2* 4+ 54 *DIAGNOST 5* 7* 5* 9* 10*	FUED R. AI (17) (17) (17) (17) (17) (17) (17) (17)	CTION CORM . COR	(AM,S,IX,R, 5),C(15) ARTHHETIC 57+1 08367.	c)	COMSTANTS PRODU		U (AM) É	STD. DAV.	with Rang	хн Noru	AL D
00101 00103 00104 00105 00106 00111 00111 00112 00113 00114 00115	1* 24 3* 4* 5* *DIAGNOST 5* 7* 5* 9* 10* 11*	FUM R, AB (0174 J=1) IF (0 10 J=0 2 U=J 2 AR IX= 5 50 IF (0	CTION (ORM 11000 11000 0 (15 (*262147))) 1.2.2 THOTOATED 13435973A3e 5=U/3435973 11 1=2.15 ((1)-barg)	(AM,S,IX,R, 5),C(15) ARTHHETIC 57+1 08367.	c)	COMSTANTS PRODU			STD. DAV.	WITH RANG	xii Noru	AL D
00101 00103 00103 00105 00105 00111 00111 00112 00114 00115 00120 00123	1* 24 3+ 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 134	FUME REAL REAL REAL REAL REAL REAL REAL REA	CTION (JORNA . HORA . HESTON B(18 (*262147 J) 1.2.2 THE JORNA +3435973836 ==U/3435973 J 11 1=2.15 (1) -5ARG) ==C(1)	(AM,S,IX,R, 5),C(15) ARTHHETIC 57+1 08367.	c)	COMSTANTS PRODU			STD. DAV.	WITH RANG	xii Noru	AL D
00101 00103 00106 00106 00105 00101 00111 00112 00115 00115 00120 00123 00124 00126	1* 2+ 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 13* 14*	FUM: Richard R	CTION (GORM) - HORM - HORM - HEION B(15 (*262147)) 1.2.2 - THOTOATU - 3435973A36 - 11 1=2.15 - (1) - 5ARG - 11 1505 - (1) - 5486 - (1) - 5486 - (1) - 5486 - (1) - 5486 - (1) - 5486	(AM,S,IX,R, 5),C(15) ARTTHMETIC 57+1 58367.	C) PERFORMED ON	COMSTANTS PRODU			STD. DEV.	WITH RAWE	xii Noru	AL D
00101 00103 00104 00105 00106 00101 00111 00112 00112 00114 00115 00120 00123 00124 00127	1* 24 3* 4+ 54 *DIAGNOST 5* 7* 5* 10* 11* 12* 13* 14* 15*	FUM. RV. RV. RV. RV. RV. RV. RV. RV. RV. RV	CTION (GORM) - HORM - H	(AM,S,IX,R, 5),C(15) ARTHHETIC 57+1 08367.	C) PERFORMED ON -B(I-1))	COMSTANTS PRODU			STP. Dev.	WITH RAWE	xii Noru	AL D
00101 00103 00103 00105 00105 00105 00111 00111 00112 00115 00115 00120 00123 90124 00126	1* 2+ 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 134	FUND READ READ READ READ READ READ READ REA	CTION (OPM - HORA - HORA - HORA (+262147)) 1.2.2 - THOTOATED +3435973A36 ==U/345973A36 ==U/345973A36 ==U/345973A36 ==U/345973A36 ==U/345973A36 =	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	C) PERFORMED ON -B(I-1))	COMSTANTS PRODU			STD. DEV.	WITH RAWE	xii Noru	AL D
00101 00103 00106 00105 00105 00105 00111 00111 00112 00115 00120 00123 00123 00127 00123 00127 00131	1* 24 34 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 13* 14* 15* 16* 17*	FUMER READ READ READ READ READ READ READ RE	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	C) PERFORMED ON -B(I-1))	COMSTANTS PRODU			STP. Dev.	WITH RAWE	xii Noru	AL D
00101 00103 00104 00105 00106 00111 00111 00112 00114 00115 00120 00123 00124 00127 00127	1* 24 3+ 4+ 54 *DIAGNOST 5* 7* 5* 9* 10* 11* 12* 134 14* 15* 17*	FUND READ READ READ READ READ READ READ REA	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	C) PERFORMED ON -B(I-1))	COMSTANTS PRODU			STP. Dev.	WITH RAWS	en Noru	AL D
00101 00103 00106 00105 00105 00105 00111 00111 00112 00115 00120 00123 00123 00127 00123 00127 00131	1* 24 34 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 13* 14* 15* 16* 17*	FUMER READ READ READ READ READ READ READ RE	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	PERFORMED ON	COMSTANTS PRODU	JCEN OVERFLOW.		STP. Dev.	WITH RAWE	xii Noru	AL D
00101 00103 00106 00105 00106 00111 00111 00112 00113 00120 00123 00124 00126 00127 00131 00131	1* 24 34 4+ 54 *DIAGNOST 5* 7* 6* 9* 10* 11* 12* 13* 14* 15* 16* 17*	FUMER READ READ READ READ READ READ READ RE	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	PERFORMED ON	CONSTANTS PRODU	JCEN OVERFLOW.		STP. Dev.	WITH RAWE	xu, Noru	AL D
00101 00103 00104 00105 00109 00111 00111 00112 00113 00124 00123 00124 00127 60120 00131 00131	1* 24 3* 49 54 *DIAGNOST 5* 7* 5* 9* 10* 11* 12* 15* 16* 17* 18* 19*	FUM. RV.A. (G17) J=1: J=1: J=1: J=1: J=1: J=1: J=1: J=1:	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	PERFORMED ON	CONSTANTS PRODU	JCEN OVERFLOW.		STP. Dev.	WITH RAWE	xu, Noru	AL D
00101 00103 00106 00105 00106 00111 00111 00112 00113 00120 00123 00124 00126 00127 00131 00131	1* 24 3* 49 54 *DIAGNOST 5* 7* 5* 9* 10* 11* 12* 15* 16* 17* 18* 19*	FUMER READ READ READ READ READ READ READ RE	CTION (JORNA . 110RA . 110RA . 11510R B (18 (*262147 J) 1.2.2 TMGICATED +3435973836 -5=U/3435973836 -11 1=2.15 -(1) -5ARG)	(AM,S,IX,R, 5),c(15) ARITHMETIC 57+1 08367. 11,9,7 (I-1))/(R(I) (I)-C(I-1))+	PERFORMED ON	CONSTANTS PRODU	JCEN OVERFLOW.		STP. Dev.	WITH RAWE	XH, NORH	AL D

-IX:	0127 0115 0101	0180 <u></u> 0105	0123; 0114		0130				7						·			
J NORM:	0101	0/11 	0112 0131	0114									 					
S :		70131 0113																
LABELS 1:	0106 0106	0111									;							
5: 7:	0115 0120 0120	0127																
11: 29:	$0115 \\ 0126$	0120 0131	0124									4				ï		
TOTEGER	0132 0138	TS	-	0176					1.									
* **	15:	0115 0104	0115 -				·			<u>:</u>			, .				,	
343597			<u> </u>				-	1 6				4		•	*			
REAL COL 0.345597	STANTS= 36+11:	0113.	**************************************						•			,			,			
El	OF UIT	IVAC 11	08 FORTE	KVM A C	OMPILAT	1011•	1 *DI	AGNOSTI C	* MESSAC	SE(S)								
13	OF UIT	IVAC 11	08 FORTE	RAM V C	OMPILAT	1011•	1 *01	AGNOSTI C	* MESSA(SE(S)								
El	O OF UI!	IVAC 11	08 FORTH		OMPILAT	1011.	1 *01	AGNOSTIC	* MESSAC	GE(S)								
E.f	O OF UIT	IVAC 11	OS FORTH	KVH A C	OMPILAT	1011.	1 *DI	AGNOSTIC	* MESSA(GE(S)			· ·					
EI	O OF UIT	IVAC 11	OS FORTE	KAN V C	OMPILAT	1011.	1 *DI	AGNOSTIC	* MESSA(SE(S)			· ·					
E1	OF UIT	IVAC 11	OS FORTE	(AN V C	OMPILAT	1011.	1 *01	AGNOSTIC	* MESSA(SE(S)								
1.3	OF U!!	IVAC 11	OS FORTE	(AN V C	OMPILAT	1011.	1 *01	AGNOSTIC	* MESSA(SE(S)								
El	OF UIT	IVAC 11	OS FORTE	(AN V C	OMPILAT	1011.	1 *01	AGNOSTIC	* MESSA(SE(S)								
E1	OF UI!	IVAC 11	OS FORTE	(AN V C	OMPILAT	1011.	1 *01	AGNOSTIC	* MESSAC	SE(S)								

	.			•									
©IR FOR MAIN FORTRAN ¥: ISO V	EBS 100 2.1			1.4			15	MAR 72	13:1	19:49.141			
THIS COMPILATION	WAS/ DONE OIL	15 MAR 72 /	T 13:19:4	9	: 1			•					
11120 001/1 14111 1411	7					·		(
MAIN PROGRAM	/			<i>f</i>									
STORAGE USED (BLOCK . NAME .	LENGTH)			<u> </u>								
				4.5			:					:	
	CODE 00370												
	DATA 00334 BLALK 00000												
9008 *	BEMI'K Johnou												
				et .				4				7	
EXTERNAL REFER	RENCES (BLOCK	(NAME.)				i i							
000 3 N	101815											1.	
	Lu2											(
	Rous												
	11015									•			
	(1024 !WOUS							<u>; ; ;</u>					
	ORT							:			•		4. Co.
	EXP6%												1
0013 h	4S10Ps										,		
												·	
STORAGE ASSIGN	MENT FOR VA	RIABLES (BL	OCK, TYPE,	RELATIVE !	COCATTON	NAME)							
					002357		0001	002366	1021	0001	000006	1076	
0001 002352			773 1000F 776 1105F	0001	003315		0001	002646		0001			
0000 001774 0001 00047.	1 1100F		001 1200F	0001	000032		0001	0000,44		0001		13106	
	1 13/26		637 13336	0001	0.03564		0001	_010056_				1 4 1 1	
0001 60313			150 1441	0001	003153		0001 0000	003161 002116		0000		2002F	
	4 150L		3224 200L	0000 0000	002100 002254		0000	002272		0001		2007F	
	7 2003F		215 2004F 374 2009F	0001	003231		0000	002422		0000		2011F	
	1 2008F 5 205L		356 209L	0000	002466		0000	002525		. ነን በ በ በ		2102F	
	2 2103F	0000 002	636 2104F	იიიი	002575_		0000	002716				2510F	
	1 2446		5313 250L	0000	002703		0000 0001	- ᲛᲘᲑᲘᲚᲜ - ᲛᲘᲙᲙᲧᲜ.		000			
	6 2511F		5335 25/IL	0001	003337 002755		0000	001761		000	-		
	<u>n 300L</u>		737 3000F	0001	000054		0001	001633	HUF	. 000			•
0001 00154 0000 00275	ა ამს. გ. 4000F		1427 403L	0001	000431	404	0001	000437		, 000			
	3 4100F	0001 001	1711 42L	0000	<u>003013</u>		0000	<u></u>		000			
0001 00000	6 4346		1724 441.	.0001	001735		nnn1 nnn1	003697			n R 001660		
000F 00512			3001 5000F	0001	857900 \$28100 p			001653		700	R 001666	A10	
0000 R 00305		0000 R 000 0000 R 00			R 001671		1000 8	001672	A129		n R 001673		
0000 R 00166 1 0000 R 00167		0000 R 00.		იიიი	R 001676	A16		001677			n R 001700 n R 001661		
1 0000 R 00107		0000 R 00	1655 A3		R_011656			?_ᲘᲘ1657_ ?_ᲘᲘ1665			n_R_001560 n_R_001560		
0000 6 00100	2 A6	0000 R 00			R 001664			C 001665 C 003172			0 0 003071		,
	2.2	- 6000 B 00.			p 003166 p 003074			0.03075		nan	ባ_ጽ_ <mark>በባ</mark> ችባንያ	CL5	
0059 R 00157			1074 Cl 7										
0050 R 00157 0000 R 00507	M. CL2	no s geografia			0 001737			2 001172			n R 001753		
0000 R 00157 0000 R 00547 0000 R 00307	M. CL2 Mr. CL7	aigun ir no.		0000 4 0000	ο 001737 ρ 001733	CP7 DP76	กกกก ห	0.01734	DP89	000	192100 8 0	F.D.T	•
0050 R 00157 0000 R 00507	77:007 14:007 14:0016	69 3 9966 69 3 9960 60 8 9666	3198 CL9 1634 02212	0000 4 0000 4000	0 001737	CP7 PP76 -ELAGT	0000 P		DPR9 FLAG2	000 000		EDT FEMAS	

g		1 1	· ·	
	0000 R 003237 FTURB	0000 P 003243 F0	0000 R 003235 F011	0000 B 003244 Ft
0000 R 001623 FTOL		0000 P 001750 F12	0000 R 001751 F121	0000_R_001752_F129
0000_R_003257_F10/	0010 R 003260 E11	0000 R 003262 F14	0000 R 003263 F15	9000 R 003264 F16
ข้องก ๊ส บอ3261 F1 <i>/</i> 5	0000 R 003236 F1325	' 0000 R 003245 F2	0000 R 003267 F25	9000 R 003246 F3
บบิบบิ ๙ บบิ3265 FX7 .	0000 R 003266 F19	0000 P 003252 F55	0000 R 003253 F6	0000 P 003254 F7
0000 <u>R 003247 E4</u>	<u> </u>		0000 I 001616 I	0000 I 001726 IB
0000 R 003255 F8	0000 R 003256 F9	0000 R 001624 G	0000 I 001620 IS	0000 T 001617 J
0000 f 00 17 25 fC	0000 I 001650 IMD /	0000 I 001622 IX	0000 I 001627 NOU	OODS R OODGOO NORM
0000 1 001621 b	9000 1 001760 L	nore I ootest N	0000 R 001703 PC11	0000 R 001704 PC12
0000 I 001625 HU	0000 I 001626 MV	0000 P 001730 PCBV	0000 R 001706 PC135	0000 R 001713 PC17
0000 R 001710 PC121	0000 R 001712 PC129	0000 R 001705 PC13	0000 R 001708 PC55	0000 R 001732 PC7
0000 & 001714 PC19	0000 R 001708 PC#	0000 P 001727 PC5	0000 R 003046 PIF	0000 R 003043 PPD
OUGO R OUTERS PUT	0000 R 001641 PP1	0000 R 001651 PI	0000 R 003174 P1	0000 R 003044 P1F
0000 R 003045 PS	ᲔᲡᲡᲡ Დ ᲛᲘᲙᲛᲜᲡ PTE	0000 R 003047 PTI	0000 R 003205 P12	0000 R 003055 P12F
0000 R 001717 P10	0000 R 003204 P11	10000 B 003,05 b110		0000 R 003211 P135
0000 R 003170 P126	0000 R 003206 P121	0000 P 003207 P129	0000 R 003210 P13	0000 R 003216 P18
0000 R 003212 P14	0000 R 003213 P15	nnno R 003214 P16	nnno R nn3215 P17	• 0000 R 003060 P22
0000 R 003217 P19	0000 R 003220 P20	0000 P 003057 P21	0000 R 001635 P21R	0000 R 001715 P3
0000 R 001535 P22F	0000 P 003061 P23	0000 R 001937 P23F	0000 R 003062 P24	0000 R 003167 P5G
0000 R 003175 P4	0000 R 003301 P49	0000 P.003176 P5	0000 R 003054 P5F	
0009 R 003177 P54	0000 8 003200 P55	0000 R 003201 P6	<u> </u>	
ยงบอ R 001716 P9	0000 K 003102 RPPR	0000 R 001747 RHOBP	0000 R 003275 RHOPD	ODDO P DOSOTO PHOTE
0000 R 003067 RHOTI	0000 R 003270 RH00	0000 P 003274 RH012	- 0000 R 003300 RH018	0000 R 003271 RH05
0000 R 003272 RH96	8988 R 803273 RH07	0000 P 001745 R0121	<u> </u>	0000 P 003277 R0135
	0000 8 003053 RPM	0000 R 003'03 RTBS	0000 R 003101 PTFH	ONDO RINGTESS RTIL
0000 R 003144 RPS	0090 K 001742 R13	0000 P 003173 SBP	nonn R onnish SIGX .	nnnn e nnnutn sigy
0000 R 001701 k12	0000 R 0005742 NO	0000 P 003171 T	0000 R 003056 TRPR	nnon p nnonnn Title
0000 R 000634 SREV	0000 P 003064 TPD	0000 R 003063 TS	0000 R 003051 TTOP	0000 R 001744 T121
9000 R 301740 TO	0000 R 001644 U	0000 B 001642 UARG	. 0000 R 001645 V	ONNO R NOIGHS VARG
0000 R 001746 T129	0000 R 001044 0	0000 R 001743 WBPS	0000 R 003221 WL1 ·	0000 R 001735, WL2
0000 K 003535 F9b	0000 K 003284 Mrv	0000 B 003225 WL5	0000 R 003226 WL6	0000 R 001755 WL7
0000 K 001735 WL3	0000 E 003230 WPRS	0000 8 003052 WPD	0000 R 003233 WT9S	ᲘᲘᲘᲘ R ᲘᲘ3234 WTEH
0900 R 003287 ELS		0000 B 003223 WB	0000 R 003043 X	0000 R 001757 XCERP
0000 R 001632 UT	0000 R 003222 W7	0000 R 003114 XK12	0000 R 003115 XK121	0000 R 003116 XK129
0000 K 003155 XKCA	0000 7, 003113 XK11	0000 R 003121 XK19	0000 R 003107 XK4	' 0000 R 003110 XK5
0000 R 003117 XK13.	. 0000 R 003120 XK17	nang p nanga XM	0000 R 001304 XMAX	0000 R 001432 YMIM
0000 R 003111 XK55	0000 R 003112 XK7	0000 R 2017C1 XRPMS	0000 R 003171 Y	0000 R 003105 YRV1
0000 R 001707 Xd121	0000 R 001711 XX129	0000 P 000276 YM	0000 R 000746 YMAX	OUD B OUTURE AMEN
2V4Y 361800 x 0000	0000 R 003133 YIII	0000 P 003145 Y10	. 0000 R 003146 Y11	0000 R 003147 Y12
- 0090 Y 003135 A0	0000 E 003134 YI	0000 P 003152 Y13	0000 R 003153 Y135	0000 R 003154 Y14
- 0000 R 003150 Y121	0000 R 005151 Y129	0000 R 003157 Y17	0000 R 003160 Y18 .	6000 R 003135 Y2
0000 R 003155 Y15	0000 R 003156 Y16	0000 P 003163 Y22	0000 R 003164 Y23 .	0000 R 003136 Y3
J000 R 003161 Y20	0008 R 003162 Y21		0000 R 003142. Y7	0000 P 003143 YB
26 16 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0000 R 003140 Y5	0,000 R 0,03141 Y6 .		0000 R 003127 710
. 0000 R 003137 Y4		0000 0 001507 7400	0000 P 003123 Z0	· · · · · · · · · · · · · · · · · · ·
0000 R 003137 14 0000 R 003144 Y9 0000 R 003130 ZIA	0000 R 001646 Z 0000 R 003131 716	0000 R 001547 ZARG 0000 P 003124 Z3 '	0000 R 003123.Z0	0000 R 003126 78

						•	•	
	00100	1*	C ·	PROGRAM MADE IS TRAMOD THIS PROGRAM IS A MATH MODEL OF THE TRA INTERHAL FLOW CIRCUITS AND)			
	00100	2*	C	THIS PROGRAM IS A MATH HODEL OF THE TEN TOT MINE CONTROL CONTROL OF THE				
	00100	*د	Ç	BALANCE PISTON WITH MONTE CARLO STATISTICAL AMALYSIS		•		
•	00100	4*	C	R.A.LIVINGSTON 12-14-71			•	
	00101	5*		1 DIMENSION TITLE (18)				
	00103	(; 4		018605108 X(86),X8(86),51GX(86),Y(74),YM(74),SIGY(74),SUMY(74),				
	00103	7*		15(L)V(70),YMAX(74),YMID(76),CYM(74),XMAY(86),XMIN(86)				
	00104	<u> </u> 25 ♦		OFFICHEROUS (15), C(15)				
	00105	9.8		READ(5,1190) (E(T),1=1,15)				
	00113	104		READ(6,1300) (C(U),d=1,15)				•
	00121	11 *		4 Et AD (5, 1000) TITLE		The same and with a bounded of a same for a same of the same of th		
-	0.0377	1. 4		19 At (5, 25,000) (53(1), [=1,06)				- interned

00176	13*	READ(5,5000)(SIGX(I),I=1,86)	
00135		5 READ(5,1105) K.IX.FTOL.6	
	• 14*	/NU=7	
00151	15+		
00152	16*	NV=5_	•
JU153	17+	/ HBU=7	
00154	10*	REAL NORM	
00154	192	EQUATE X AND Y TO MAIN PROGRAM VARIABLE	ES CONTRACTOR (MACE) OTT)
00155	26+	EQUIVALENCE (X(1), PPO), (X(2), P1F), (X(3)	(), P5), (X(4), P1E), (X(5), P(1)
00156	21*	FOUTVALENCE (X(6),PT2),(X(7),TT5P),(X	6)*Abu)*(X(3)*KbW)
00157	22+	EDITO VALCUOTE (Y(10).PSF).(Y(11).P12F).	(X(12),TBPR)
00160	23*	Figure Value Cheef (x (13), P21), (X (14), P22), ()	((151,P23),(Y(16),P24)
00161	244	C. 117 /11 CHCC (V(17) .TS1. (V(18) .TPD) . (X	(19),AT1),(X(20),AI2)
		GZ 13 3 MAL TRICK (X (21) • PHOT)	[] * (A(SS) *KHOLE) * (X(S2) * CPT)
60162	25+	EMILANTERICE (R(SA) CFS) (X(S2) CF3) (((26)+CL4)+(X(27)+CL5)
00163	20+	LOUIVALENCE (X(28),CLE),(X(29),CL7),($(301 \cdot C(8) \cdot (X(31) \cdot RTEH))$
00164	21*	EQUIVALENCE (X(32) + POPP) + (X(33) + RTPS)	(Y(3/1)*RPBS)*(Y(35)*YBV1)
00192	, 28+	EGGIANTERCE (X(39) ABAS) (X(32) XKR) ((V/30).VV5).(Y/30).YK55)
00166	يو ر <u>يا اخ</u>	EGGLANTERCE (X (39)) LRAS (1 (VEG))	(A)
00167	30*	EQUIVALENCE (X(40), XX7), (X(41), XK11),	(A)
00170	31*	EQUIVALENCE (X(40), XK120), (X(45), XK13) + (\ (\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
00171	32+	COUTVALENCE (X (43), XXXV), (X (44), ZO),	(Y(50):23 //(X(51):26)
00172	33*	EQUIVALENCE (X(52),Z8),(X(53),Z10),(X	(54),714),(X(55),Z16)
00173	34*	manyun sucs (v(tc), vn 1, (v(t7), vTH), (((58),Y1),(X(59),Y2)
00174	35+	EXITED COOK (Y(60), YS), (Y(61), YU), (Y((2),Y5),(X(63),Y6),(X(64),T/)
00175 -	J17#	EGG 7515005 (V(651, Ya), (V(66), Y9), (Y	57),Y10),(X(68),Y11)
	37+	EMOTO A PHOTE (Y(A0), Y12), (Y(70), Y121),	(Y(71)+Y\29)+\X(72)+Y\3)
00176			(Y(75),Y15),(X(75),Y16)
90177_	31, *	EGUIVALENCE (X(77),Y17), (X(78),Y18),((79), (20), (3(80), (21))
0.013.00	46ان	EQUIVALENCE (x(s1), y22), (x(s2), y23),	(Y(83),C012),(X(84),C013)
00201	4+(j 4.	ECHIVALFACE (XMITTEET (XMAZITES)	
00202	41+	EQUIVALENCE (X(85),P50),(Y(86),P126) EQUIVALENCE (Y(1),T),(Y(2),CFNP),(Y(3) cop), (y(#), D1), (y(5), P4)
ີ່ ອຸນຊຸບິລີ	472+	EDUIANTEMOC (ACI) (LACS) (CERNAL CERNAL CER), 79::: 14(1)
00204	63.4	EGUIVALERCE (Y(6),P5),(Y(7),P5%),(Y(8) Pan Pa
60205	14 14 4.	ECHIVAL PUCE (Y(11), Po), (Y(12), P11), (Y	(13),012),(4(14),P(21)
00206	454	EGUIVALENCE (Y(15), P129), (Y(16), P13),	(4(17), 1135), (4(18), 114)
00267	464	EQUIVALENCE (Y(19).P15).(Y(20).P16).((21),017),(Y(22),P)B)
00210	47*	= -1 =	Y(25), WL11, (Y(26), W7)
-00211	148 ¥	C. GIVELLEGIT (Y(27), 98), (Y(29), 19, 4), (Y	(29), ML5), (Y(30), ML6)
	494	CONTRACTOR (V/31).M G1.(V/30).MPRC).	(Y(33),WEPR),(Y(34),WBP)
00212			• (Y(37)•F0]1)• (Y(38)••1385)
00713	5U±	E303 USC (5000 (2720) - CT1003) - (Y(40) + E31)	• (Y(41)•EMZ)• (Y(42)•EMON)
00at14	51*	EQUIVALENCE (Y(43), F0), (Y(40), F1), (Y(45).F2).(Y(46).F3).(Y(47).F4)
00215	52*	EGGIVALENCE (Y(48), F5), (Y(49), FRV), (Y	(50)-555)-(Y(51)-56)
00216	53*	EGGIANI TICE CALGRAPATOR CALGRAPATOR	Fu). (V(SS). F10)
00z17	544	EQUIVALENCE (Y(52), F7), (Y(53), F8), (Y(04/76-74-1-04/7-1-04-7-1-04-7-1-04/7
00220	55*	EQUIVALENCE (Y(56),F11),(Y(57),F13),(1109/1744/1/109/17E10/
00221	50+	EUNIVALENCE (Y(60), F16), (Y(61), E17), (I(bz1):14/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/
00222	57*	COLOVAL CROS (Y(60), PHOO), (Y(65), PHOS)	, (Y(66),RH06), (Y(67),RH07)
00223	584 -	CALLED STOCK (V140) - DHN12) - (V169) - PHOF	D) * (Y(70) *!(0129)
00729	59*	EQUIVALENCE (Y(71), R0135), (Y(72), RH01	8),(Y(73),P49),(Y(74),P119)
00225	60+	FLAG3=0	
	61*	EQ 310 P=1.80	
00226		X(N)=X(d)	
00231	<u> </u>	316 X(11)((a)=X(1(b))	
00528	65*	016 ACTIONS - NAME OF A	
00234	64 *	gri=upi)*(1Tepr)	
00.255_	<u> </u>	RITE-GOLIK (GGO-GIL) /ALI**5	
00236	+ ران	DP2124=P21+P24	
00237	υ7≇	P21R=(PTI-P21)/WT1**2	
00240	03*	P28F=(P22-P24)/D22124	
00241	647	P23F=(P23-224)/0P2124	
00252	70 *	9 WRITE(n.2000) FITHE	
00272	71 +	Sec. 170 (7.490101 F	
1111. 1111	/ 1 *·	ARITE (CASUMI) BOUADIE OCADIE BLIADIE	TTOD, WPD, PPM

```
WRITE(6:2002) RHOTI-RHOTE FTOL G. TBPR. TS. TPD
         73.*
00266
                      ARTTE (6,2003) CL1.CL2.CL3.CL4.CL5.CL6.CL7.CL8
00277
          744
                      WRITE(6,2009) RTEH, RUPR, RTBS, RPBS, P5F, P12F, P5G, P126
00311
          75*
                      WKITE (6:2007)
                                             20,23,26,28,210,214,216
.00323
         766
                      WRITE (6.2004) XK4.XK5.XK55.XK9V.XK7.YK11.XK12.XK121.XK129.XK13.
00334
         774
                     1XK17, AK19
00034
         781*
                      ASKITC(6,2005) Y1,Y2,Y3,Y4,Y5,Y4,Y7,Y8,Y9,Y10,Y11,Y12,YIH,Y0
00352
         798
                      ERITE (6,20)6) Y121, Y129, Y13, Y135, Y14, Y15, Y16, Y17, Y18, Y20, Y21,
00372
         00*
00372
         01+
                      1422,423
                                          CD12,CD13, AT1,AT2,YBV1,YBV2
                      (806S+6) ETTEM
50411
         82.*
                      ERTIC(6,4000)
                                         P21, P22, P23, P24
05421
         115 ≠
                      60 TO 12
00927
         34*
                  400 DO 260 I=1.K
004.30
         85+
                  402 DO 410 J=1.86
00433
         3114
                       X(J)=HORM(XM(J),SIGX(J), (X,B,C)
         87+
00436
                       IF(X(J)-XWAX(J)) 404,404,403
00437
         68*
                  403 XMAX(J)=X(J)_
00442
         89*
                  404 Ir (X(J)-XATH(J)) 405,410,410
00443
          90+
                  405 X6.III(J)=Y(J)
          91*
09446
                  410 CONTINUE
00447
         92*
       *DIAGNOSTIC* THE TRAUSFER TO 12 IS BAD BECAUSE 12 IS NOT IN THE INNERMOST DO OF A NEST.
00450
                       RTT=UPD+(A.-TEPR)
         93 x
00451
                       THE FOLLOWING 5 STATEMENTS REVISE TURB, PRESS. DISTRIBUTION
          998
00451
                       PITEPPD-RTIL/RHOTI+WTI++2
บบนุรลิ
          95*
                       P21=PTI-P21R*WTI**2
00453
          964
                       1922124=221-224
69454
          974
                       F22=P24+P22F*DP2124
บบ45ธี
          96*
                       P23=P24+P23F*DP2124
00455
          1364
                    12 PUI=PPO+PIF
00457
         100*
                       PU1=PPOIP1F
         101 6
609600
                       PEERDIAPSE
00461
         1024
                       1749=175-1756
00462
         1034
                       P12=PP0-(1.-P12F)*(PP0-P01)
         104+
00463
                       P119=P12-P126
         105 r
00464
                       UARG=PS
00465
         105*
                       VARGETS
        1074
00456
                       CALL HEU2 (HOU, H, V, Z, NH, NV, HARG, VARG, ZARG, IHD)
         1055
00407
00470
         1094
                      FHOUSERARG
                       บผย6≕ยร์
00471
         1164
                       VARG=.5*(IS+TPD)
         111*
 00472
                       CALL TLUZ (HDU, H, V, Z, MU, NV, UARG, VARG, ZARG, IHD)
00473
         112*
                                                                                               . .
                       RHO5=ZARG
         1156
 00474
                       UNEG= 1.5+P5
         1144
 00475
                     * VARC=100+7.
 00476
         115*
                       CILL ILUS (HUU, U, V, Z, NU, NV, UARG, VAPG, ZARG, IND)
         116*
 00477
         117*
                       RH06=24R6
 00500
                       UAPG=PF0 * . 73
 00501
         1150
         119*
                       VARG=(PI)
 00502
                       CALL ILUZ (MOU, U. V. Z. NU, NY, UARG, VARG, ZARG, IND)
         120+
 00503
                       EHC7=2006
 00504
         121*
                       UAPG=P12.
 00505
         122*
                       CGT=OGAV
00506
         125*
                       CALL TEUR (NOU, U, V, Z, NU, NV, HARG, VARG, ZARG, IND)
         124*
 00567
                       ELCIZ=ZARG
 03510
         125*
                       E0129#H012
 00511
         1000
       127*
                       VARGETPU+7.
60512
 00513
         125*
                       UAPG=P5++S
                       CALL TEUR (NOU, U. V. Z.HU, NV, UARG, VARG, ZARG, IND)
         129*
 00514
       21501
                       e0135=2586 ______
 60515
                       19,00 = 21
         1510
 00 410
```

		Part of a
00517	132*	VARG=IPD
00520	1334	CALL TLUE (NDU:U:V:Z:NU:NV:HARG:VARG:ZARG:IND)
00521	134*	/Rh018=ZARG
00522	135+	/ UARGEPPD
0.0523	1.36+	/ VAPG=1PD
00524	137*	CALL TEUR (PDU-U-V-Z-PU-NV-UARG-VARG-IND)
00525	136*	MIOPD=ZARG
00525	139+	CL 1=CL1/RH65
00525 <u>_</u> 00527	140*	CL2=CL2/RH07
	141*	CL3=CL37R1012
00530		CL = CL = XRH012
00531_	142+	
00525	145.	CL5=CL5/RH012
00533	主持许本	CL6=CL678:IO12
00534	145,*	CL7=CL7/261918
60535	146*	CLN=ULAZ#HOT1
00536	147*	RIEU=RTEUZROTI
00537	1964	963PPENW/2ZP0335
00540	149+	RTBS=RTPSZ9FGPO
60541	150 *	RPRSZ:RPSZ:PDPD
00562	~ 151+	P1=3+1(15/2
00543	152*	AU=1:1+Y1++2
00544	155*	AL-DY-LVI LC VOLTO
20545	154*	A1=P1+(Y3++2=T2++2) A2=P1+(Y3++2=Y2++2)
90540	155*	AS=P1+(Y4**2-Y3**2)
00547	150*	A4=04 (Y5 k + 2-Yn mg2)
	157*	AS=P4+(Y5*+2-Y6V2+42)
00559_	154*	A.V=P1. (Y3V2**2-Y3V1**2)
00551		A35=P14*(P8V1**2~Y6***2)
00552	159*	
0.0557	160*	A ₀ =P1+(Y6+12-Y7++2)
90554	1613	A7=P1+(Y7+12-Yx+x2)
00555	102*	-A8=PI+(Y9++2+Y8++2)
00556	↓ 05*	A9EPT*(Y10**2-Y0**2)
30557	104*	A16=P1+(Y11++2-Y10++2).
りりちもり	165*	A11=P1+(Y12+*2-Y11**2)
00561	Lock	A12=P1*(Y121+*2-Y12+*2)
00562	167*	V1S1=L1*(\151**S-153**S)
00563	166*	.A124=#1+(Y129++2-Y13+*2)
00564	109*	A13=P1*(Y15**2-Y14**2)
00505	170+	A14=P1*(Y14**2-Y15**2)
00565	171*	A15=P1+(Y15**2-Y16**2)
00567	172*	A14-91-(Y17+29-Y16+k2)
		A17=1*(Y16**2-Y17**2)
00570	173*	A19=P1*(Y20**2-Y18**2)
60571	170×	XRP05=,0055*RP0**276
00572	175+	
00572	170*	C II.ITTALIZE P15.P19.P20
00573	177*	P19=PTE+10.
00574	176*	P80::P19
00575	179+	15 P18=P19+.2+(PP0-PTE)
00576	130*	PC4=ARPP5+tH05+XK4++2+(Y5++2-Y4++2)
00577	131+	PC11=XRP/IS+RN012*XK11**2*(Y12**2=Y11**2)
00600	132*	PC12=xRPmSyldIC12*(Y121**2 -Y12**2)*XK12**2
00001	105*	20 PC13=XRP15 kR0135 *XK13 * *2* (Y13 * *2~Y135 * *2)
30662_	104 *	PC139=XRPHS+R0135*XK13*+2*(Y135**2=Y14**2)
00603	1054	Xi(121=)((0.45+(Y121*+2-Y120*+2)+XK121*+2
	ا انان+ 1نن+	PC121=X:31 *RH012
00504		XK129=XRP45*(Y129**2-Y13**2)*XK129**2
00665_	10/4	
UUUU	160 9	25 PC129=XF1Z=+RH012
00607	169+	FC17=X8P15+P4B018*XK174*P*(Y18**2=Y17**2) PC19=XP1P4S(PHOT1+XK19**2*(Y20++2=Y1P4*2)
- 606.10	190 *	

00611	192*	1 ightharpoonup 2	
00612	5	(°3=P01 °	
_ 00013	194*	/ Pn=P49-PC4	
00613	195*	/ P/=.5*(P01+PP0)	
	196*	/ P9=P01	
_00515	820.t 197*	/ P10=P01	
00016		30 P11=P119=PC11	
00617	196+	P135=P6+.020*(PPD=PS)	
00029			
00621	2004	P13=P135+PC13	
00622	201*	P14=P135-PC135	
00623	202*	SuP=_A121*(P12-P13)/IIBP	
00624	203*	35 FLA61=0	
00025	504*	FLAG2=0	
nuodo	2054	FLA69=0	
00527	205*	FLAG7=0	
00630	. 207+	01=0.	
000551		1000	
0000082	209+	(c=0	
00033	210:	30 PC0=260P05+R1005+ 2K5**2*(Y5**2-Y8V2**2)	
	211.	PCOV=RRI 15+RH06+YK6V++2+(Y9V2++2-Y8V1++2)	
00635 r	212.	PL55=Xid*45*Rid06*XIC55*42*(YBV1**2=Y6**2)	
	2134	P54#275-FC5	
00000	2104	PROTEINS COV	
_ 90637 .		Po=203-Pr65	
(1) (14 ()	215*	39 PC7#XIGPUS*9B07 *(Y7+*2-Y8**2)*XK7**2	
willing to 1	2101		
00648	1121/1	POTE Y-PCT	
00542	216*	C STATERENT'S RO-45 ITERATIVELY COMPUTE P7	
いけいにう	219*	40 6/276=1/2=1/6	
00644	2:00	Gr/89=pn=P9	
60645	55.14	EL2=590 (A35 (0076) /CL2) * 0076 / A35 (0076)	
Contro	2823	WESESCRY (ARS (DRA9) ACES) *DRA9/ABS (DRA9)	
60547	225+	6P0SEAL218L3	
ົ ປປວນປີ	221,0	CP7=PPPP-S++37APS(WPSS)	
00051	225+	IF (ABS ((P7-CP7)/CP7)0010) 44.44.42	
00054	226+	42 P7=.5+ (P7+CP7)	
	221*	1,21041	
50555 50556	220+	.16 (18-25)40,40,301	
20061	229*	44, P7=CP7	
		99 PAEP7-PE7	
(0)062	230* 231*	IF (FLAG7) 45,45,49	
90663			
00006_	2324_	45 UARGEP7	
биьо7	230+	VARGETING	
00670	239*	CALL THUS (HOU, U.V.Z.NU.NV. WARG. VARG. ZARG. I'D)	
00571	2.352#	CL2ECL2*RB077ZARG	
000,72	236+	CL3=CL3+RH07/ZARG	
00073	237*	RHO7=ZARG	
00074	23.1*	FLAG7=1	
-000.75	239#	$C = T_0$: XC	
00076	240*	ла сторь «льфотжуромс» Хкбжэр*RHO6*(Y5**2*YPV2**?-•5*(Y5**4+YBV2**4))	
69678 69677	2414	FUS=PUN-ASS-PI-*XPPMS+XK55+*2+RH06*(YBV)+*2*Y6**25+(Y6**4+YEV1**4	
	242+	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
05677		Ftv=P54+ABV-P1*YRPM5*XKBV**2*RH06*(YBV2**2*YBV1**2-•5*(YBV2**4+YBV	
06760	243+		
00760	2464	11(2(4))	
00701	245+	FU=76+(P6+P7)*A6 F7=P6+A7 -3-141*XPPHS*XK7**2*PH0PD*(Y8**2*Y7**2*-5*(Y7**4+Y6**4))	
00702	240*		
36703	24/*	F8=73+(P8+P9)+A8	
00704	240+	IF (FLAGA) 50.50.62	
00707	2404	\$6 F6=At+20+(P\$+P\$)	
UU101			
00707	250+	F1=.5*(P1+P01)*A1	

00712	252*	F3=Z5*(FD[+P4)*A3	
00713	<u>255</u> *	F4=P4*A4 3.141*XRPMS*XK4**2*PH05*(Y4**2*Y5**25*(Y4**4+Y5**4))	
-60714	254*	/F9=P014A9	
00715	255*	66 F10=210*(P91+P11)*A10	
00716	256*	F11=P11*A11 -3.141*XRPMS*XK11**2*RH012*(Y11**2*Y12**25*(Y12**4+	·
00715	257*	/ (Yi)++4))	
	25u≠	Fij)=#PD**2/(3864*RF05*AT1)	
50717		FIURCEP1*(P21*(Y21**2-Y20**2)- P22*(Y21**2-Y22**2)+(P23-P24)*(Y23*	
_00720	259*	1*2-455*****	
00720	260 k		•
00721	261*	F25=P1+Y22+*2+PTE	
00732		68 F011=F0-F1+F2+F3+F4-F5-F6-F7+F8+F9+F10+F11-F55-F8V	
10723	2031	IF (FLAGA) 100,100,113	
00723	264*	C STATEMENTS 108-200 ITTERATIVELY COMPUTE BAL. PISTON POSITION	
_0u <u>7</u> 25	205 r	100 T=.5*TTPP	
60727	2001	TO=1 Test = T	
00730	, 267*	101 IC=IC+1	•
00731	268*	TF (IC-25)102,102,300	
00734	26134	102 (:12=.05070/(G*R5012*(CD12*(Y12+Y121)*(TO))**2)	
60735	270+	P13=.050707(0*R0129*(CD13*(Y129+Y13)*T)**?)	
00736		WEPS=(P) P-P13+PC12-PC121-PC129)/(R12+R13)	
00737	272*	P121=P12=R12+EDPS+PC12	
00740	273*	100 UARG=P121	
00740	274+	C THE FULLOWING IS AN EMPIRICAL FON.	• •
-00741-	275*	T121=190+6.2-375.*T0	
00742	270*	VAP6=T121	
60743	277 +	CALL TEUS (HDU, U, V, Z, HU, NV, HARG, VARG, ZARG, IND)	
		R0121=2786	
00744	2764		
00745	279*	PC121= R0121*XM121 P129=P121=PC121	
00745	280*		
00747	201*	UNPGEP129	
00747	252+	C THE FOLLOWING IS AN EMPIRICAL EON.	
00759	_233+	T129=TPD+14./(1000.*T0)**.42	
00751	204	VARGE 1129	
06752	265+	CALL TEU2 CIDU. U. V. Z. HU. HV. WARG. VARG. ZAPG. IND)	•
00753	280*	P0129=2ARG	
00754	207*	20057=.50*(20121+20129)	
00755	266*	PC121= CHORP*XM121	
0J756	2690	PC129=X0129+R0129	
-00757	290*	(1895)181-PC121	
00760	291*	106 F12=A12 W121	X_{ij} , which is the X_{ij} -density X_{ij}
00761	2924	F121=P129*A121-3.141*XRPMS*XK121**2*R0129*(Y121**2*Y129**25*(Y12	<u> </u>
_00761	5354	11449+(129449))	
		F129=A129+P13	
00762	294 k		
00763	295*	(p) (5=p) (5-p) (1)	
00764	2904	WL5=5WRT (A95 (DPL5) /CL5) *AR5 (DPL5) /DPL5	
00765	297∗ -	M12=.05070/(G*RH012*(CD12*(Y12+Y121)*(TO))**2)	
00766	296*	R13=+U5070/(5*P0129*(CD13*(Y129+Y13)*T)**2)	
00767	299*	111 PDF=59RT((P1Z-P134PC12-PC121-PC129)/(E12+R13))	
00770	300*	WEPREMEPHALS	
6077L	301∗_	113 P135=66+B3PR*#BPR*+2	
00772	3U2*	119 P13=P139+PC15	
00773	303*	P14=P135-PC135	
00779	339*	115 P16=P15	
00/75	305*	6rt,o=r16-P194PC17	
08776	300+	WL6=306T(A9S(UPL6)/(CL6+CL7))*ABS(DPL6)/OPL6	
03777	307*	10.77 ALG	
_ 01000 01000	w r re		
	31,11	%1:5=#1,5+yL6	
	1.15.73		
01000	3094 3164	P16=PP0=PTAS*0T8S**2	

			P NAME CO.
			· · · · · · · · · · · · · · · · · · ·
01004	312*	WTEH=WL8+WL7	
		P20=PTE+BTEH*NTEH**2+.30*PC19	
01005		/ P19=P20=PC19	
01003	314*		
51007	315*	/ P1E=P19+CL7*#L7**?	
01010	310*	/ P17=P1n=PC17	
01011	317+	F13TF14+A13-3-141*XPPMS*XK13**2*R0135*(Y13**2*Y14**25*(Y13**4+Y1	
01011	313*	14**4)}	
01012	319*	125 F10=614 +710+(P10+P15)	
01015	320+	F15=A15*•5*(P15+P16)	
01014	321*	F16=A16 *Z16*(P16+P17)	
01017	322*	F17=A17 *,S*(P17+P1a)	
	325+	F16=A10+P19-P1+XRPH5+XK19**2*RHOTI*(Y20**2**18**25*(Y20**4+Y18**	
01016		14)	· · · · · · · · · · · · · · · · · · ·
01015	3214		
0.1917.	32u*	F1325=-F13-F14-F15+F16+F17+F19+FTUR9-F25	
01020	326∗	136 FM2=(PH+P3FR) +#2/(G+RH012*AT2)	•
01621	, 327*	FMON=FM1+F112	
01022	326.*	F) P=F(J) 1+F1325+FMOM	
01023	527+	137 CFBP=F121+F129+F12	
01020	350*	WRITE (I. AND) TATOAFSPACESP	
01038	- 331 -	3002 FORMAT (1X, PRITE F8, S, 5X, 3HTO= FA, 5, 5X, 4HFPP= E12.4, 5X, 5HCFBP= E12.4	
01032	332+	1,/)	
01032	333+	A TO THE STATE OF	
		138 Te (AUS (EISC-CERP) - F (OL) 2007/2007/40	
61935	33 <u>+</u> <u>*</u>	140 A CLAOC FASTANIA FASTA	
01041	335*	191 () = (CF90-F90/SBP	
0.1042	336 €	FEAGE=1	
01043	337*	162 (ET+0)	
01644	330 *	143 \F(1) 140, 144, 145	· · · · · · · · · · · · · · · · · · ·
01047	339*	144 T=.00001	
01050	346+	60 TO 197	
01051	3417	195 17 (1150-11196,196,197	
01054	3424	196 Tattur00001	
	343*	147 TO=TT-0T	
01055		XCF192=CL3P=F1325=FM2	•
0.0056	544+		f
01057	≱ ر‡4ق	GO TO 101	
01060	346.8	300 WRITE(6,3006) Y.FBP.CFBP	
01005	34.74	60 10 209	
01055	, 340 A	301 NRTTE (6+8001) CP7	
01071	34,9+	60 10 699	
01072	350+	150 SCPEAUS ((CFOP-F1325-FM2-XCFOP)/DT)	, in the second
01073	351+	60 TO 141	· · · · · · · · · · · · · · · · · · ·
01074	352 €	200 IF (FLAG4) 201-201-205	
manage appropriate to the same	353+	C THE PULLULITY 4 STATEMENTS CORRECT THE DENSITY AT STA. 6	•
01074		201 VARG# (Y129+WBPR+TPD+wL2)/(WBPR+WL2)	
01077	354*		
01100	<u>555</u> +	1/kg=i/t,	
01101	356+	CALL TLUE (MDU-U-V-Z-MU-NV-UARG-VARG-ZARG-IMD)	
01102	357 ★ .		· .
01103	354*	FLA64=1	
01104	359*	FEA67=0	
01105		GO TO 38	
01106		205 WL1=SGRT ((P4-P3)/CL1)	
01107	362+	%L 4=5-;₹ (((() 1 - 2) 0) / CL4)	
· U1110	305*	IF (FLAG3) 209,209,25U	
	364 €	250 DO 260 J=1.72	
11113			
. 61116		SUMY (J) = SUMY (J) +Y (J)	
01117	360∗	SHOV (J) = SHOV (J) + (Y (J) - YM (J)) **?	
01130	357∗	17 (Y(J)-YMAX(J))255•259•254	
01123	30n+	254 YMAX (J) = Y (J)	
91124	3094	255 JF (Y(J)-76IH(U))256,256,260	
01127		250 Y: (1) (J) = Y (J)	The state of the s
01130		26a CC91 G38	•
11 1 1 2 11	0113	respectively. Many	

		- Page // a
01133	372*	450 GO TO 460
01134	373∗	209 WRITE (6:2100) T.CEBP.SDP
01141	374+	210/P2131 (6, 2101)PS-P1-P.)I-P4-P49-P5-P54-P55-P6-P7-P8
	375*	WRITE(6,2102) PD1,P11,P119,P12,P121,P129,P135,P14,P15,P16
01156		MRITE (6,2103) P17,P18,P19,P20,P21,P22,P23,P24
01173	370*	220 WRITE (6:2104) WL 1:97 : 188 : ML 4: 18L 5: ML 6: ML 8: MPBS: WBPR: WBP: WTBS: WTEH
01205	377×	220 WRITE (6.2194) WITH A LAST SECTION OF A
01223	370+	WRITE (6,2105) RHOD, RHOS, PHOS, PHO7, RHO12, RHOPP
01233	379+	WRITE (6:2106) [121:T129:R0121:R0129:R0135:RH/18
01243	3801	40116 (6.2011) F011.F1325.FTURB.FM1.FM2.FM0M
01253	381*	WRITE (6,4160)F0.F1.F2.F3.F4.F5.F6V.F55.F6.F7.F8.F9.F10.F11.F011
		WRITE (6.4200)F13,E14,F15,E16,F17,F19,E25,E1325
_01279	362+	FLA63=1
01366	383*	
02.597	354,*	224 DO 225 L=1.74
01312	3115+	ANTH(F) EA(II)
01315	386 €	225 Y _F (L)=Y(L)
01315	307+	YeAX(36)=Y(38)
01316	໌ 388∗	226 1F(K) 9 ⁽¹⁾ , 10 ⁰ , 10 ⁰
01371	3(14)	460 NO 470 J=1.74
		SIGY(J)=SGGT(SHDV(J)/FLOAT(K))
015/4	4.062	
AND IN THE RESIDENCE	- 391*	470 CYE(J)=SURY(J) ZFLOAT(K)
0.1327	392×	WRITE (6-2500)
01331	3 95∓	WRITE(6,2501) (1,XM(I),SIGX(I),YMIN(I),XMAX(I),(=1,92)
01543	394*	1 D T T L (d = 25.2 C)
01.595	3954	WELTE (5, 25, 1) (J, YM(J), CYM(J), SIGY(J), YMIN(J), J=1,63)
0.5500	3961	999 CONTINUE
	397+	1000 FURMA((1900)
0.500.}	and the second second	iisu repulitare.u)
01362	5981	
61363	399*	110t, FORMAT (2/12:2F12:0)
01564	1, (31) +	1200 FORMAT(7F18.0)
	401*	2500 FOR ATTUME, SLY, THEOT VARIABLES, /// 10X, VARIABLE, 10X, MEAN, 12X
01365	402×	1, WARLANCE 1, LOX, TELTH. X1, 10X, TMAX. X1./)
	4034	2500 February (1547-171-173-68) F12-5-58/F12-5-58/F12-5-51/
01.566	404+	2510 FUREAT CHIL, 54X, OUTPUT DATA / / / / SX, VARTABLE . 10X, MEAN 10X, TRIA
01.567		1L PEARLY BX. STO. DEV. 1.10X, MIN. Y'.10X, MAX. Y'./)
0.5-7	405+	2511 FORMAT(8Y, 1Y1, 13,6X,F12.5,5X,E12.5, 5X,E12.5,5X,E12.5)
01370	4Úc,*	2511 FORMATIC BY, TY, 13, BA, FIZ. 51, SA, F
01371	407+	2000 FORMAT CHILL SHITPA THRUST PALATICE AND THIERMAL FLOW PROGRAM. REV.
0.571	408*	101-10-72+////1X+19A4+//)
01572	409*	2001 SANKATIIY-MARRA SALAHRIFEE6.4.5X.3HPSEE6.4.5X.4HPIFEE6.4.5X.
		14EPT1=F6.0.77.17.4HPTC= F6.0.5X.5HTTBP=F8.5.5X.4HWPD= F6.0.4X.4HRP .
01372	410+	
01372	411+	28= Fo.0.//)
01573	415*	2002 FORMAT (1X,6HBHOTTE F9.5,5X,6HBHOTE F9.5,5X,6HFTO) = F8.1,5X,2HG F :
01573	410*	
01574	4144	2003 FORMAT(1X, MICLI= E12.4.5X, 4HCL2= E12.4.5X, 4HCL3= E12.4.5X, 4HCL4=
01374		1530 4.77.17.
	fi 1 ' \ *	
	415*	9 9101 6=512.8.5X.0HCL 6=512.4.5X.4HCL?=512.4.5X.4HCL9=512.4.
01.574	410*	2 4HCL5=E12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4.
01374 01374	410* 417*.	2 4HCL5=E12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL8=E12.4.
01.574	410* 417* . 410*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4. 3//) 2004 FORMAT(1X.4HXK4=F6.4.5X.4HXK5=F6.4.5X.5HXK55=F6.4.5X.5HXK8V=F6.4.
01374 01374	410* 417*.	2 4HCLS=F12.4.5X.4HCLG=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4. 3//) 2004 FOPMAT(1X.4HLK4=F6.4.5X.4HXK5=F6.4.5X.5HXK85=F6.4.5X.5HXK8V=F6.4.
01374 01374 01375 01375	410* 417* . 410*	2 4HCLS=F12.4.5X.4HCLG=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4. 3//) 2004 FOPMAT(1X.4HLK4=F6.4.5X.4HXK5=F6.4.5X.5HXK85=F6.4.5X.5HXK8V=F6.4.
01374 01374 01375 01375 01375	410* 417* . 410* 419* 420*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4. 3//) 2004 FORMAT(1X.4HXK4=F6.4.5X.4HXK5=F6.4.5X.5HXK5=F6.4.5X.5HXK8V=F6.4. 15X. 4HXK7=F6.4.5X.5HXK12=F6.4.7/.1X 2.5HXK12=F6.4.5X.5HXK12=F6.4.5X.6HXK120= F6.4.5X.5HXK13= F6.4.5X.
01374 01374 01375 01375 01375 01375	415* 417* 410* 419* 420* 421*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4. 3//) 2004 FORMAT(1X.4HXK4=F6.4.5X.4HXK5=F6.4.5X.5HXK5=F6.4.5X.5HXK8V=F6.4. 15X. 4HXK7=F6.4.5X.5HXK12=F6.4.7/.1Y 2.5HXK12=F6.4.5X.6HXK121=F6.4.5X.6HXK120= F6.4.5X.5HXK13= F6.4.5X.
01374 01374 01375 01375 01375 01375	410* 417* 510* 419* 420* 421*	2 4HCLS=F12.4.5X.4HCL6=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4
01374 01374 01375 01375 01375 01375 01376	410* 417*. 410* 419* 420* 421* 422* 423*	2 4HCLS=F12.4.5X.4HCL6=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4
01374 01374 01375 01375 01375 01375 01376 01376 01377	415* 417* 410* 419* 420* 421* 422* 423* 423*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.5HXKRV=F6.4.5X.5HXKRV=F6.4.5X.5HXKRV=F6.4.5X.5HXKRV=F6.4.5X.5HXKRV=F6.4.5X.5HXKRV=F6.4.5X.5HXK12=F6.4.5X.5HXK12=F6.4.5X.6HXK13=F6.4.5X.6HXK
01374 01374 01375 01375 01375 01375 01376	410* 417*. 410* 419* 420* 421* 422* 423*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.5HCR9=F12.4.5X.5HCR
01374 01374 01375 01375 01375 01375 01376 01376 01377	415* 417* 410* 419* 420* 421* 422* 423* 423*	2 4HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.4HCL9=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.5HCCN=E12.4.5X.6HCC
01374 01374 01375 01375 01375 01375 01376 01377 01377 01377	410* 417*. 410* 419* 420* 421* 422* 423* 425* 426*	2 9HCL5=F12.4.5X.4HCL6=F12.4.5X.4HCL7=E12.4.5X.4HCL7=E12.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.4.4.5X.4HCL9=E12.
01374 01375 01375 01375 01375 01376 01376 01377 01377 01377 01377	415* 417* 410* 419* 420* 421* 422* 423* 423* 425* 427*	2 4HCLS=F12.4.5X.4HCLG=F12.4.5X.4HCLV=E12.4.5X.4HCLQ=E12.4.5X.4HCL
01374 01374 01375 01375 01375 01375 01376 01377 01377 01377 01377 01377	415* 417* 410* 419* 420* 421* 422* 425* 425* 427* 427*	2 4HCLS=F12.4.5X.4HCL6=F12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4. 3//) 2004 FOPMAT(1X.6HXK4=F6.4.5X.4HXKS=F6.4.5X.5HXKS5=F6.4.5X.5HXKRV=F6.4. ESX. 4HXK7=F6.4.5X.6HXK12=F6.4.7/.1V
01374 01374 01375 01375 01375 01375 01376 01376 01377 01377 01377 01377 01460 01400	410* 417* 410* 410* 421* 421* 422* 423* 423* 425* 427* 427* 429*	2 4)CL5=F12.4.5X.4HCL6=F12.4.5X.4HCLV=E12.4.5X.4HCLV=E12.4.5X.4HCL9=E12.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.5X.4HCl9=E12.4.4.4.4HCl9=E
01374 01374 01375 01375 01375 01375 01376 01377 01377 01377 01377 01377	410* 417* 410* 410* 421* 421* 422* 423* 423* 425* 427* 427* 429*	2 9//CLS=F12.4.5X.4HCLG=F12.4.5X.4HCLV=E12.4.5X.4HCLV=E12.4.5X.4HCLS=F12.4.4.5X.4HCLS=F12.4.4.5X.4HCLS=F12.4.4.5X.4HCLS=F12.4.4.5X.4HCLS=F12.4.4.5X.4HCLS=F12.4.4.4.4HCLS=F12.4.4.4.4HCLS=F12.4.4.4.4HCLS

```
01401
         432*
                     1.3
                                                                  54RTEH= E12.4.5X.5HRBPR=
                  2009 FORMAT(1%.
 01402
         433+
                      2 E12.4.5X,5HRTB5= E12.4.//,1X,5HRPB5= E12.4.5X,4HP5F= F8.5. 5X,5HP
         43.14
 01402
                     /312F= F8.5.5X.4HP5G= F10.2.5X.5HP12G= F10.2.//)
         435*
 01462
                  2010 FURMAT CEX, THUMBER OF TRIALS FOR MONTE CARLO ANALYSIS =1.1X.16.//.
01403
         430 *
                     TIX, GLAN VALUES OF IMPUT VARIABLES, ... //)
 01463
         437 %
                  2011 FORMAT(5X+5HF01)= E12.4+5X+6HF1325= E12.4+5Y+6HFTHB= E12.4+5X+
 01464
         4381
                      1//.5x,4dF41= F8.0,5X,4HFM2= F8.0.5X,5HFM0M= F9.0,//)
 01404
         4.59 %
                  2100 FORMATCHILLSX. COMPUTED PARAMETERS PASED ON MEAN VALUE OF INPUT VA
 91495
         440*
                                                        -///5X.3AHBAL. PISTON INNER LAND C
                      IRIABLES!!
 01405
         441*
                      BLEARANCE (T) =F8.4.//.5X.16HBAL.PISTON LOAD=F10.1.//.5X.12HSTIFFNE
 01405
         442*
                      455 = E12.4. ///)
 01405
         443*
                  2101 FORMAT(57,38PS= F7.2,4X,3HP1=F7.2,4X,4HP01=F7.2,4X,3HP4=F7.1,4X,5H
         tillal k
 01406
                      1845= F7.1.5%, 3HP5= F7.1.//, 5X, 4HP54= F7.1.
         4454
 61405
                             4X,448-55=F7.1,4X.38P6=F7.1,4X.38P7=F7.1,4X.3HP8=F7.1.//)
         4404
 01406
                  2102 FORMAT(5X, MEPO1= F7.1, 4X, MEP11=F7.1, 4X, 5HP119= F7.1, 4X, 4HP12= F7
 01407 , 447+
                      1.1,0%,50P121= F7.1,0%,50P129= F7.1,0%,0PP13=F7.1./.1%,5PP135=F7.1.
01407
         44434
                      2011P19= F7.1.4X,00P15= F7.1.0X,00P16= F7.1. //)
 01407
         11404
                                    5X,4HP17=F6.1,4X,4HP18=F6.1,4X,4HP19=F6.1,4X,4HP20=
                  2163 FORMAT(
 01410
         4 15 (14)
                      1Fg. 1,4X,4HP21=F6.1,4X,4HP222=F6,1,//,5XL
 01410 74514
                                                            4HP23=F6.1.4X,4HP24=F6.1.///)
         452*
 01410
                  2104 FURMAT (5X,4HWL1=F7.3,4X,4HWL2=F7.3,4X,4HWL3=F7.3,4X,4HWL4=F7.3,4X,
         455*
 01411
                      1464-L5=F7.3,4X,419L6=F7.3,5X,4H9L8= F7.3.
         454*
 0.14.11
                                       //,5X,54UPDS=F7,3,4X,5HMBPR==7,3,//,5X,
 91411
         4:5:54
                      44:000P= F7.3,4X,500/T0S= F7.3,4X,500/TEH= F7.3,//,)
 01411
         4504
                  2105 FORMAT(1X, EHRHOO=F9.5, 5X, 5HPHO5=F9.5, 5X, 5HRHO6=F9.5, 5X, 5HRHO7=F9.5
 01412
         457*
                      1.5X. OHRHO12=F9.5.5X. OHRHOPD= F9.5.//.)
 01412
         453*
                  2106 FORMAT(1X,5HT12)= F8.2,5X,5HT129= F8.2,5Y,6HR0121= F9.5,5X,6HR0129
 01413
         459*
                      1= F9.5,//,1%,6HR0135= F9.5,5%,6HRH018= F9.5,//)
         4668
 01413
                  3000 FURNATION TITERATION FAILED TO CONVERGE AT T= F7.5.5X.4HFRP=
         461.
 03414
                      1512.9.58.58.6FBP= E12.4.//)
         4004
 01414
                  3001 FORMAT (1411-41HITERATION SOLUTION FOR PT FAILED AT CPT= F6.0)
 01415
         400*
                                                  7HP21-24= 4(F7.1,3X,),//)
                  4000 FORMALLIKA
         4616+
 01416
                                                                           4HF8V=F9.0 +5X+4
                  4100 FORMAT(5X, 9HF0 TH 5 = 6F9.0.//,5X,
 01417
         465*
                      14855=F9.0 ,//.5X,100F6 TH 11 = 6F9.0,5X,5HF011= F9.0,//)
 01417
         4600
                  4200 FORMAT (5X, 10HF13 TH 17= 5F9.0, //, 5X, 4HF19=F9.0, 5X, 4HF25= F9.0, 5X, 6
         110/8
 01420
                      1HE 1325= F9.07//)
 01420
         408*
                  4300 FORMAT(5X, 1J1, I3, 10Y, E12, 4, 20X, 1J1, I3, 10X, E12, 4))
 0.421
          4698
                  5000 FORBAT (5815.0)
 111462
          470+
         471*
                       GO TO 4
 01423
                       EHO
         472*
 01424
```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

1 *DIAGNOSTIC* MESSAGE(S)

R XOT MAIN			ora tara			•			15 MAR 72	13:	19:56.7	Utr .				
•	/-	1 1	1 1 2 1 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	1 . 0 . 1 to . 10	ia igua pa	ergal estrative as gara congress as necigales inglescor	in a primate	011,4216								
				1	in a single of the single of t	engantera (1866) Englis protesti de Carlo (1884) (1868)	To go of the good	(२.५) २२२ (२.५)	7111							
		. 1			1 - 1 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 7 11 1	eriter oerito	. F1 4 7 . F1 (1) 4 . 1								
															· 	
														<i>i</i> .		
. "				ng kasa kata Marangan												
7 14							().*****			. ,						
					17,117,1		1.41.21.11.	, (**) · (*) }					•.			
						•)		, 		<u> </u>	
	· · · · · · · · · · · · · · · · · · ·	•														
1.7.4										**			· · · · ·			• •
						. 3					Ť					
		. "							i e'	•					· · · · · · · · · · · · · · · · · · ·	
								•			•					
<u></u>												· · · · · · · · · · · · · · · · · · ·	· .	·		
•							•									
			•	F	1 1									:		
				:		-							,	,		
appropriate and additional of the contract of		, had taken ye ya figo h substitutionistic of the Let Service 9.		1		alayan a shaqar di dada dada da shikan . A		-						and the second seco		•

						
TPA THRUST BALANCE AND INTERNAL FLOW PROGRAM. REV. 01-10-72	•				Phyline y is	
TPA 24,239 RPM NORMAL MODE, DATA LIST DID. 1-10-71			•			
NUMBER OF TRIALS FOR MONTE CARLO ANALYSIS = 0						
	The second secon		4		i	
			·		j	
		•				
				•		
					•	
	. :					
				1		
				٠.		
		` •				
			+'.			
01429 460* 1HF1325= F9.0*//)						
01421 469* 4360 FORMAT(5X,*J*,13,10X,F12.4,20X,*J*,13,: 01422 470* 5000 FORMAT(5F15.0) 01423 471* 60 10 4			· · · · · · · · · · · · · · · · · · ·			
	<u>GMOSTIC* MESSAG</u>	E(S)	•			
			•			

•

								Aurora de la composición dela composición de la composición de la composición de la composición dela composición de la composición de la composición de la composición dela composición de la composición de la composición dela composición de la composición de la composición de la composición dela composición de la composición de la composición dela compo
		•				-		
				· · · · · · · · · · · · · · · · · · ·				
				<u> </u>	: 			
						-		
							,	
			:					
				·				
								4
			* 43 .					
		•	• •	•				
						,		
	•							
	•						•	

15 MAR 72 13:19:56.704 O XOT MAIN . .

24.239 RPM NOVEMAL MODE, DATA LIST DTD. 1-10-71
DER OF TRIALS FOR MONTE CARLO ANALYSIS = 0
N VALUES OF INPUT VARIABLES.
= 1442. P1F= .5000 PS= 25. PIF= .0700 PTT= 1077.
= 750. TTEP= .02500 WPD= 46. RPM=24239.
TI= .00038 RHOTE= .00029 FTOL= 100.0 G= 386.00
98= .0000 TS= 41.00 TPD= 60.00
= .1590+00 Ct2= .4250+00 Ct3= .1430+01 Ct4= .1590+00
5= .3020+01 CL6= .1710+01 CL7= .2000-01 CL8= .7600-01
H= .1450-02 RUPK= .5000-02 RTBS= .3460+90
S= .1320+00 P5F= .79000 P12F= .75700 P5G= 10.00 P12G= t0.00
: .50000 Z3= .500 Z6= .500 Z8= .500 Z10= .500 Z14= .500 Z16= .500
= .4800 XK5= .6800 XK55= .2400 XK8V= .9800 XK7= .4800 XK11= .4800
12= .4800 XK121= .4800 XK129= .4800 XK13= .4800 XK17= .4800 XK19= .4800
TH Y12= 3.4500 3.2500 3.4500 3.6500 5.4750 2.7500
2.7500 1.5150 1.5150 3.4500 3.6500 5.5000 5.
∃= 1.4000 Yô= 4.7500
21= 5.7000
5= 1.5150 Y17= 1.5150 Y18= 1.9000 Y20= 3.9000 Y21= 5.1830 Y22= 3.9000 Y23= 5.1830
12= .8500
1= 15.000 ATZ= 15.000 YEV1= 4.000 YEV2= 5.000

....

i

	MA.	the second	,				
 1=	•01250	то= 101250	FBP=	.6121+05	CFBP=	.7012+05	
- 1=	.01664	TO= /.00836	FUP=	•6177+05	CFBP=	•7031+05	
Τ=	.02087	TO= .00413	FOP=	•6194+05	CFRP=	•4734+05	
	.01820	TO= .00680	FbP=	.6173+05 /	CEBP=	•5039+05	Theration data setting FBP = CFBP (varying T)
	•01709	TO= .00731	FibP=	•6165+05	CFBP=	•6400+05	(varying T)
τ=	•01795	ro= .00705	FBP=	.6172+05	CFRP=	•6257±05	
	.01809	TO= .00691	FBP=	•6169+05	CFRP=	·6174+05 /	
	•01009 .	. ro= •u0691	FuP=	•6175+05	CFRP=	. 6174+05	4
	. ,						
	**						
					•		
				:			
						,	
					4		
							*
•					•		
		<u> </u>					
			. •.				
	•						
•							
			· .		· · · · ·		
			•				
							

COMPUTED PARAMETERS CASED ON MEAN VALUE OF INPUT VARIABLES. BAL. PISTON INNER LAND CLEARANCE (T) = .0181 BAL.PISTON LOAD= 61744.3 STIFFNESS = .587a+07 PS= 25.00 PI= 24.09 PDI= 100.94 P4= 470.3 P49= 559.6 P54= 521.4 P55= 540.5 P6= 330.4 P7= 1040.3 P8= 1014.9 Pol= 721.0 P11= 1175.2 P119= 1256.8 P12= 1266.8 P121= 871.4 P129= 764.9 P13= 416.2 P135= 416.2P14= 465.4 P15= 1125.9 P16= 1125.9 P17= 753.6 P18= 760.1 P19= 755.7 P20= 764.2 P2:= 964.2 P22= 901.6 P23= 798.9 P24= 749.8 WL8= 1.001 WERS= 2.753 WERR= 5.549 WDP= 5.784 WTBS= 1.511 WTEH= 1.746 RH00= .00256 RH05= .00250 RH06= .00250 RH07= +00250 RH012= .00250 RH0PD= .00250 T129= 66.22 R0121= .00250 1121= 03.61 R0129= .00250 RV135= .00250 KH018= .00250 Full= .6707+65 F1328= -.5648+04 FTURB= .4089+04 FM1= 146. FM2= 191. FMOM= 337. Fu TH 5 = 918. 263. 425. 1294. 27175. 9280. Fav= 17301. F55= 91a2. Fo Tri 11 = 0. 17397. 0. 21761. 4229. 64665. F011= 67065. F13 [H 17= 2875. 1845. 0. 3127. FL9= 27594. F25= 35838. F1325= -5648.

11. LH₂ PUMP TEST DATA REDUCTION PROGRAM

- 	**************************************	<u> </u>							d		
							·				
	•										
					-		,				
, ,				•	***************************************	e		<u>,</u>	JN 1251	7 011	t/
			• , 4	•	·				MITTOUR		
		<u> </u>	<u> </u>				-:-10	/	(1:7)	N & 300	
				<u></u>		777	7 V/		121	1780565	/
·						, D,	ברר וו	7 - 13 - 2	1 11	Moor	!
	•					and si	רבעוני	73 9H	<u>/</u>	NITSI	
	•		1			namdonal	^2 <u>@</u> -	ONENI	no Com!	2/ 117	
• : .	•		* • • • •	*			www.ener.r.,		72007	JUNIT	1935
											7
	j		> .	W	4Y20Yd	NOILON	RED	ATAU	TEST	AMUA	, "H7
		11:08:55·21¢	ST 99A 20							ATA	ם ברז ס
		#88*6T:80:TT	ST A9A Z0						•	רז בוצד	3 10
				:			· .			1	
		£\$\$.01:80:11	ST 99A 20						1	XZZZħZ=NI	ט כזב ט
······································		11:08:10.523	ST A9A 20					4 .	001.5.6	+5824 • QV1	ผ∩ช 6๗
		PAGE 1	ST ASA BO BIAC	1			•	0.2.100	170.42824		THE WATERWAY PROPERTY

.

			namen and a second control of the second con										
<u> </u>				<u> </u>			· .		 		·		
	· · · · · · · · · · · · · · · · · · ·	•	•				···-		 ,				
	-			•	*	•							
			\	•		•			,				
•				•									
	**************************************			1						·.			
,													
							No.						
			•										
		<u></u>		* * * :		:						•.	
		7										*	
		/		\$,	
:	•							,			· · · · · · · · · · · · · · · · · · ·		
			Nov-01400111	C/ data	Su								
								1 /	. ,		. ,		
·····		<u></u>	71:00:11.	ST and	50	produce established to the same and a second t)
			11:08:5H					·	 :		1 1517		

	The second of the second	(1445 - 17 Th) - White a management at the size of the company of the size of the company of the									e kanangan e arago, wa kanp arabahan mandahan mandahan	
٠.											٠	
-1		TAD: 428249	2.100 .					DATE 05 AF	R 72 PAGE	ন		
				. *	•			n', Al	1) 70 111	08:10.557		
		T 04T4 1 700005	1100		1.0			11,4		•		
	G E	T DATA:1.720405, 4	1102									
1		/										*
,	000001	/9 10 11 13	3 15 16 16	17 17 18	19 20 43 43	43 43 43	42 42 42 4	12 42 41 40	11:	nd: 10.527		
	000002	40 40 39 39	9 38				32.4000	34.2000	36.0000	*		
)	000003	24.9029	25.2000	27.0000	28.8000	30.6000	32.4000	34.2000	50.000			
	000004	36.4823 0.20788	0.20828	0.21058	0.21305	0.21575	0.21869	0.224874	m0.225281:	00:10:500		
	000005 000006	0.22632	0.20020	0.21030	0,21000	0.222.0						
)	0000007	-132.27	-131.80	-128.88	-125.77	-122.46	-118.96	-115.25	-111.28			
	000008	-110.18							0761	naina Eth		
}	000009	1.186	1.205	1.316	1.427	1.539	1.650	1.761	10 71.8741	1114 1 1 1 1 1 4 1 1 4 H		
·	000010	1.905_		07 0000	00 8000	30.6000	32.4000	34.2000	36.0000			
	000011	24.9336	25.2000 39.0995	27.0000	28.8000		7.7	3.42.000	4.0.2.301.5		i	
ز	000012,	37.8000 	D m. 20A12	C 16. 2116427	70021289/	Abreak59/	1/0.21853	0.22163	0.22512			
	000014	0.22894	0.23196									
,	000014	-131.97	-131.55	-128.65	-125.53	-122.25	-118.75	-115.02	-111.07			
1	000016	-106.85_	-103.63			1 5 7 6	1.648	1.759	1.872			
	600017	1.186	1.202	1.314	1.425	1.536	1.040	1.00				
	000018	1.985 24.9641	· 2.070	27.0000	28.8000	30.6000	32.4000	34.2000	36.0000			
	000019	37.8000	39.6000	41.1497	201000						•	*, •
	000020	0.20772	0.20804	0.21026	0.21281	0.21543	0.21829	0.22147	0.22489	<u>:</u>		
j. '	000022	0.22870	0.23291	0.23697					110.00			
-	000023	-131.67	-131.31	-128.39	-125.30	-122.01	-118.51	-114.80	-110.86		,	
b	000024	-106.66	-102.16	-9.8 • 0.4	1.424	1.534	1.645	1.757	1.869	•		
. –	000025	1.985	1.201 2.099	2.201	1.424	16,754	14075					
Ť	000026 000027	25.0254	25.2000	27.0000"	28.8000	30.6000	32.4000	34.2000	36.0000			
§ 1	000027	37.8000	39.6000	41.4000	43.2000	44.3376						
	-000029	0.20756	0.20780	0.21003	0.21249	0.21511	0.21797	0.22107	0.22449	•	•	
1	000030	0.22814	0.23236	0.23705	0.24237	0.24618	*** 07	-114.38	-110.45			
¥	000031	-131.10	-130.82	-127.92 -96.99	-124.83 -91.85	-121.54 -88.38	-118.07	-114.00	-1104-3			
4	000032	-106.27 1.187	1.197	1.309	1.420	1.530	1.641	1.752	1.863			
§.)	000033 000034	1.977	2.092	2.211	2.333	2.412						
§	000035	25.0865	25.2000	27.0000	28.8000	30.6000	32.4000	34.2000	36.0000	- Ĉ		
3	000036	37.8000	39.6000	41.4000	43.2000	45.0000	.46.8000	46.8414	0.22401		ř	
4	000037	0.20740	0.20756	0.20979	0.21225	0.214769	0.21766 0.25493	0.25508	1 0.22401	•		
	000038	0.22767	0.23180 -130.35	0.23641 -127.45	0.24157 -124.36	+121.10	-117.62	-113.95	-110.03			
₫ ; 8	000039 000040	-130.52 -105.87	-101.43	- 96.67	-91.56	-86.03	79.95	'-79.80				
j	000041	1.187	1.194	1.305	1.415	1.526	1.636	1.747	1.859		-	
4	000042	1.971	2.086	2.203	2.324	2.450	2.581	2.585 34.2000	36.0000		•	
1	000043	25.1459	25.2000	27.0000	28.8000	30.6000	32.4000 46.8000	48.6000	48.9365			
<u> </u>	000044	37.8000	39,6000	41.4000	43.2000 0.21193	45.0000 0.21456	0.21734	0.22036	0.22362			
g .	000045	0.20724 0.22719	0.20732	0.20955 0.23577	0.24086	0.24674	0.25381	0.26232	0.26414			
-	000045	-129.95	-129.86		-123.89	-120.63	-117.17	-113.50	-109.60			
	000047	-105.46	-101.05	-96.33	-91.26	-85.80	-79.80	~73.17	-71.85		, b.	
4	000049	1.188	1.192	1.302	1.412	1.522	1.631	1.743	1.853			
- S	000050	1.965	2.079		2.316	2.639	2.570	2.709 36.0000	2.737 37.8000	*.		
4.)	000051	25.2071	27.0000 41.4000	28.8000 43.2000	30.6000 45.0000	32.4500 46.8600	34.2000 48.6000	50.4000	50.7564			
4 -	000052	39.6000 0.20709	0.20931	0.21162	0.21424	0.21694	0.21996	0.22322	0.22679		<a hre<="" td=""><td></td>	
4.	000055	0.23009	0.23514	0.24014	0.24587	0.25762	0.26089	0.27130	0.27368			~
1	000055	-129.37	-126.49			-116.72	-113.08	109.19	-105.06			
,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							, ,,,-	* * * * * * * * * * * * * * * * * * * *			

, e.g. og er grennennen	TAD:428249	.2.100					DATE 05 AF	PR 72 PAGE	F 4
000057	1.188 2.073	1.298	1.408 2.308	1.517 2.430	· 1.628 2.559	1.738	1.848	1.959	
6 m058 900059	25.2665	27.0000	28.8000	30.6000	32.4000	34.2000	36.0000	37.8000	
000000	39.6000	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52.2000	
000000	52.3745		1012100	130000	,	,0,0,0		1	
11990962	0.20693	0.20907	0.21138	0.21392	0.21662	0.21956	0.22282	0.22632	
000063	0.23021	0.23450	0.23943	0.24507	0.25159	0.25945	0.26923	0.28242	
010064	0.28401								
000065	-128.79	-126.02	-122.97	-119.71	-116+28	-112.63	-108.77	-104.65	
000066	-100.30	-95.63	-90.66	-85.29	-79.48	- 73∙09	-65.90	- 57•50	
000067	-56.58								
000068	1.189	1.295	1.405	1.514	1.623	1.733	1.843	1.953	
000069	2.007	2.182	2.299	2.421	2.547	2.682	2.827	2.990	
000070	3.008			30 6000	70 0000	70.000	36 0000	37.8000	
0000 71	25.3278	27.0000 41.4000	28.8000 43.2000	30.6000 45.0000	32.4000 46.8000	34.2000 48.6000	36.0000 50.4000	52.2800	•
000072 0000 73	39. 6000 5 3. 8380	41.4000	43.2000	45.0000	40.0000	40.0000	30.4000	36. • 2.00V	$ ilde{m{t}}$
000073	0.20677	0.20883	0.21114	0.21360	0.21630	0.21924	0.22242	0.22584	
600074	0.22965	0.23395	0.23871	0.24420	0.25055	0.25810	0.26748	0.27964	f
000075	0.29561	0.220070	OFLUCITI	J = 2. () E. ()	5 11.5.7.7.55	0.20010			!
0000/7	-128.22	-125.53	-122.48	-119.26	-115.83	-112.18	-108.34	-104.25	
000078	-99.92	-95.29	-90.34	-85.03	-79.29	-73.00	-65.98	-57.92	
000079	-48.92								
บบบบลย	1.189	1.291	1.401	1.510	1.619	1.728	1.837	1.949	
000081	2.060	2.175	2.291	2.412	2.538	2.669	2.810	2.968	
280000	3.137_								
600083	25.3871	27.0000	28.8000	30.6000	32.4000	34.2000	36.0000	37.8000	1
050084	39,6000	41.4000	43.2000	45.0000	46.8000	48:6000	50.4000	52.2000	
000085	54.0000	55.1717		0.0177	0.04.000	0 01007	0 20207	0.22544	
000036	0.20661	0.20860	0.21082	0.21336	0.21599	0.21893	0.22203 0.26573	0.27710	
000087	0.22918 0.29315	0.23339 0.30896	0.23808	0.24340	0.24960	0.25683	V • 20013	0.467730	
000088 00089	-127.64	-125.06	-122.01	-118.79	-115.38	-111.75	-107.91	-103.84	
000009	-99.53	-94.93	-90.02	-84.77	-79.10	-72.89	-66.05	-58.24	
000691	-48.84	-41.01	20 - 0 -	****					•
000092	1.189	1.289	1.407	1.506	1.615	1.724	1.833	1.943	
000093	2.054	2.168	2.284	2.404	2.527	2.657	2.795	2.948	
000094	3,124	3.267							
000095	25.4465	27.0000	28.8000	30.6000	32.4000	34.20.00		37.8000	3
000096	39.6000	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52.2000	A contract of the contract of
000097	54.0000	55.8000	56.4029					4 00505	
009038	0.20645	0.20836	0.21058	0.21305	0.21567	0.21853	0.22163		•
000099	0.22870	0.23283	0.23744	0.24261	0.24865	0.25564	0.26414	0.27487	
000100	0.28933	0.31238	0.32525	-118.32	-114.91	-111.31	-107.49	-103.44	,
000101	-127.07 -99.15	-124.59	-121.54 -89.70	-84.50	-78.87	-72.79	-66.07	-58.48	
000102 000103	-49.15 -49.56	-94.56 -37.94	-32.54	-04.00	-10.01	· 1 C 0 1 3	50,407	9.74.40	•
000103	1.190	1.285	1.394	1.502	1.511	1.719	1.828	1.938	
000105	2.048	2.162	2.277	2.394	2.517	2.644	2.780	2.929	
.000103	3.096	3.308	3.404	2,40,77					
000107	25.5960	27.0000	28,8000	30.6000	32.4000	34.2000	36.0000	37.8000	
000108	39,6000	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52+2000	
000109	54.0000	55.8000	57.6000	59.1047					\$
000110	0.20613	0.20772	0.2095	0.21241	0.21495	0.21773	0.22075	0.22401	
000111	0.22751	0.23148	0.23585	0.24078	0.24542	0.25294	0.26057	0.26994	
000112	0.28186	0.29847_	0.32597	0.41744					
000113	-125.62	-123.40	-120.37	-117-17	-113.78	-110.20	-106.42	-102.41	يوس خيسي
000114	-98.17	-93.65	-88-87	-83.77	-78.29	-72.40	- 65•96	- 58•86	*
000115	~ 50.78	-41.12	-28.19	-1.36					

	N. C. Seattle		D VS PAGE						5.100		
Using College Calcard											
Dylar Dilar Dilar Dilar Dilar Dylar Dyla											
Daylet 0 612 m 2 622	Park to the first the control of the										
Design D											
DUTATE DITAGE DITAGE DESCRIPTION SALES DITAGE								100.8.001	0000.*66		
DUINTER DIAMES DESCRIPTO SECRETO SEC											
DUINT 0 61245 0 6223.70 9348.70 9348.70 7242			18885.0								
09190 01400 01400 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 000000											
U918'C G120'C SECRIC S	•										
091870 012870 012871 050871 050870 12322 02282			6421n+2	OCRIO*2	CTC94 T	927.86*T	29ncΩ*T				
			TRUIDIT		Pn. 601-	PALCI11	60.591.65				
UST	!	•									
	,		S9.50								
			10.721								
	· ·										
Unit								975.1	1.269	1.193	
0000 0000			5.849					S.SIII	. 5.130		851900
0008.45		<u> </u>	176.8								
0008.472 0000.482 0009.482 0009.482 0009.483		•									
0005.52 0004.00 0004.00 0004.00 0004.00 0005.00 0004.00 0004.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0004.00 0005.00 0005.00 0004.00 0005.00 0005.00 0005.00 0004.00 0005.00 0005.00 0004.00 0004.00 0005.00 0004.00 0005.00 0004.00 0004.00 0005.00 0004.0	* · · *		. 111+0	917 • 9	969+9	566.49	P+258				
0000.00			0008.75	0000-95	<u> </u>	0004.05	0003.05				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$. •									
Output O	•										
MirkSi, O. Linis, O. Seciss, O. 1801S, O. 18		manage in the case of the same of			1.						
Marie Mari											
Maria Mari						00. (40.	040 7 100				
#1025.0 #1262.0 10104.0 #1025.0 \$7705.		· · · · · · · · · · · · · · · · · · ·		0.21813	0.21535	0.21281	0.21042				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			0.25914	0.25214	0.24610						
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		· · · · · · · · · · · · · · · · · · ·			16498.0	0.32351	07308.0	72685.0	0.27726		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		The system to the School						\$2518.0	81967.0	95449 <u>0</u>	000728
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			59005*1	0798#•I	T'illon	15992*1	4661£*1				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			90 00-	201-	20 703						
$\begin{array}{cccccccccccccccccccccccccccccccccccc$) .									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		· · · · · · · · · · · · · · · · · · ·									
$\begin{array}{cccccccccccccccccccccccccccccccccccc$											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$. ,		0			034.00*				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				1.782	949*1	1777.1	59h•T				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	•									166°T	000705
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<u> </u>										
$\begin{array}{cccccccccccccccccccccccccccccccccccc$											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			7T+1.+Q	846 • 9	T92•9	272*9	ntr+9				
000159			0008.77	0000.35	2002-112	0004.95	0008-05				
0001409 54,0000 55,8000 57,6000 75,9000 75,6000 64,8000 64,8000 64,8000 64,0000 64,8000 64,8000 64,8000 75,9000 75,6000 91,8000 92,8000 95,8000 95,8000 90,170 000172 0.88800 84,8000 10,8000	•										
000170											
000171 628 6000 64,6000 64,6000 64,8000 96,8000 90,8000 91,8000 93,6000 95,4000 071000 071,8000 99,0000 100,8000 0,8000 0,80000 0,8000						0009.27					
~						00H0*Ub					
18888.0											
0418E.0 917#E.0 9ESSE.0 3980E.0 FAORS.0 2846S.0 EVADS.0 . EVADS.0											
07320											
	The state of the s				- 700 (4 ° U				64404.0	2 000 7 0	

	サメロ いいつのつのひょ	2/100					BATE OF AP	R 12 PAGE	<u> </u>			/ 4	
		0.12651	0.16934	0 3+678	n.39637	0.29813	0.32843	0.36602					
000177	0.ds208 0.40281	0.43897	0.47433	0.21074	0.25687	2.605				· · · · · · · · · · · · · · · · · · ·			
000178 000179	-118.47		-T14.46	-Pring-	36.56	2104.6f	2100.98	7204712					
	/ =93.09	1-88-83	4-84.37	79.66	1-74.66	1-69.42	1-63.85	1297.92					
000180 000181	-51.59	-44.81	-37.40	-29.30	-20.24	-9.96	1.98	16.01					
000182	32.24	49.35	65.54	79.83	11.02.37	103.48	113,55						
000182	131.44	139.59	1147.33	1154.77	ⁿ r61∵94°	0168.89	1175.65	0182.29					
000184	188.75	195.10	201.42										
000185	1.199	1.238	11.343	11.449	-117555	11.657	11.751	-11:865					
000136	1.969	2.074	2.180	-2.288	72.395	~2.506	2.518	~2.733 7.063					
000187	2.853	2.976	3.106	3.246	3.395	3.561_	3.749	3.962					
000108	4.202	4.449	4:676	4.873	5.041	5 186	5.315	5.430					
000189	5.535	5 634	5.724	5.809	5.690	5+966	6 • 039	6.109					
030190	6.176	6.242	6.304										
000191	26.6130	27.0000	28:8000		32.4000	34.2000	36.0000	37.8000					
000191	39.6000	41:4000	43.2000	45:0000	4 6: 8000	48.6000	50.4000	52.2000			1		
000192,	54.0000	55.8000	57.6000	59.4000	61.2000	63,0000_	64.8000	_66,6000					
030193	68.4000	70.2000	72.0000	73.8000	75.6000	77.4000	79.2000	81.0000			i		
000194	82.8000	84.6000	86.4000	88.2000	90.0000	91.8000	93.6000	95.4000			1		
000195	97.2000	99.0000	100.8000										
030197	0.20367	0.20407	0.20597	0.20804	0.21019	0.21257	0.21503	0121773					
	0.22060	0.22369	0.22711	0.23077	0.23574	0.23911	0.24396	0.24936					
000198 000199	0.25540	0.20224	0.27002	0.27916	0.28981	0.30268	0.31834	n.33789					
	0.36236	0.39280	0.42936	0.47092	0.51518	0.55984	0.60379	0.64614		. •	•	1.1	
000200	0.68699	0.72524	0.76415	0.00611	0.04164	0.07520	0.10982	0.14272					
000201	0.17490	0.20645	0.23744	**, -2-					· · · · · · · · · · · · · · · · · · ·				
000202	-115.64	-115.02	-112.09	-109.02		-102.35	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	204.97		,			
000203	-90.98	86.82	-82.45	777.84	"-73,"00	1-67-92	1 -1 62∓55	-56.00					
000204	-50.90	-44.53	-37.72	-30.41	-22.50	-13.86	-4.37	6.14					
000205	17.78	30.52			74,95	83.37	04.82	105.42					
000500	115.25	124.40	133.15	141.40	Dt49.31	0156.91	11611.26	0171.39					
090207	178.32	185.10	191.86									· 	
600508	1,201	1.224	[†] 1.329-	11:432	1:535	11.638	1.741	1.843					
000209	1.946	2.049	2.152	2.257	2.362	2.469	~2157B	-2.688					
000210	2.801	2.917	3.036	3.162	3.292	3.432	3.580	3.740					
000211	3.913	4.097	4.207	4:475	4:653	4:814	4:961	5.093					
000212	5.213	5.323	5,425	5.519	ទី តែពីនិ	5:692	5:771	5.847					-
000213	5.213	5.988	6.056	0,102			'		* -				
000214	26.8955	27. 0000	28.8000	30.6666	32:4000	34:2000	36:0004	37.8000	*				
000215	39.6000	41.4000	43:2000	45.0000	46:8000	48:6008	50:4000	52:2000	₹.				
000216	59.6000 54.0090	55.8000	57:6000	59.4000	61.2100	63.0000		66.6000					
000217	68,4000	70.2000	72.0000	73.8000	75.6000	77.4000	79.2000	51.0000					
000218	82.8000	84.5000	86.4000	88.2000	90.0100	91.8000	93.6000	45.4000					
000219	97.2000	99.0000	100.8000	001200									
000220	0.20295	0.20311	0.20494	0.20693	-666 BS Q	0.21130	0.21368	0.21622					
000221	0.20293	0.22187	0.22505	0.22846	0.23220	0.23625	0.24070	0.24555	`		•		
000222	0.25095	0.25691	0.26367	0.27122	0.27996	0.28997	0.30165	0.31548_					
000223	0.25095	0.35116	0.37397	0.40035	0.42083	0.46186	0.49535	0.52948	•				
000224	0.56358	0.59703	0.62985	0.66196	0.69319	0.72370	0.75350	0.78267					
000225		0.04458	0.07199									·	
000226	0.01652 -112.80	-112.63	-109.73	-Y08"88	-1:03.46	-100°03	96.53	-92.79					
000227		-84.77	-80.47	-106.68 -75.07	1-71-25	⁷⁶ 66930	912764	5255988					
0.00558	-88.87	-43.87	-37.66	1-10-86	-23.43	-15.69	-7.40	1.55	•		•	والمستوال المستواد	
000229	-49.90		32.54	nn ns		67.63	0.76.08						
000230	11.17	21.51	36.59	128-73	137.26	145.45	153.32	160.94	* *				
000231	100.54	110.43	119.82	9.486.48	721.50	1.10170	200.00						
#00232	168.39	175.55	162.67		1, 618	11,620	1.722		<u>ــــــــــــــــــــــــــــــــــــ</u>				
000233 000234	1.205 1.924	2.026	2.128	2.230	2.333	2.436		2.647			**		
		2 - 11 2 6 -											-

	TAD: 428249	2,100 .					DATE 05 AP	R 72 PAGE	7	P41.77
000237	4.933	5.052	5.161 5.836	5•264	5.359	5.449	5.534	5.615		
000238	5.692	5.765 28.2000	30.6000	32.4000	34.20.00	36.0000	37.8000	39.6000		
000239	27.1745	43.2000	45.0000	46.8000	49.6000	50.4000	52.2000	54.0000		
000240	/41.4000		59.4000	61.2000	63.0000	64.8000	66,6000	68.4000		
000241	/ 55.8000	57.6000	73.8000	75.6000	77,4000	79.2000	81.0000	82.8000		
000242	70.2000	72.0000	88.2000	90.0000	91.3000	93.6000	95.4000	97.2000		
000243	84.6000	86.4000 100.8000	6042000	90.0000	, , , , , , , , ,					
000244	99.0000		0.20589	0.20788	0.21003	0.21233	0.21479	0.21742		
009295	0.20232	0.20399	0.22640	0.22989	0.21003	0.23776	0.24221	0.24706		•
000246	0.22020	0.22322		0.27233	0.28067	0.29013	0.30094	0.31325		
000247	0.25238	0.25834	0.26494			0.43047	0.45653	0.48355		
000248	0.32740	0.34369	0.36213	0.38287	0.40575	0.43047	0.67157	0.69692		
000249	0.51097	0.53846	0.56580	0.59290	0.61052	0.64574	0.01131	0.000024		
0Hu250	0.72179_	0.74635				00.00	-90.60	1-86.74		
000251	-109.96	-107.36	-104.33	-101.15	-97.81	=94.29	~54.25	-48.73	1	
900252	-82.70	-7 8.46	-74.05	-69.44	-64.60	-59.54	-0.85	7.67		
000253	-42.91	-36.81	-30.39	-23.63	-16.46	-8.89		88.55		
000254	16.69	26.21	36.19	46.51	57.07	67.69	78.23		i i	
000255	98.53	108.17	117.43	126.34	134.92	143.19	151.21	158.97		
000256	166.52	173.99								
000257	1.207	1.299	1,401	1.503	1.603	1.703	1.803	1.904		
000258	2.003	. 2.103	2.203	2.304	2.405	2.507	2.610	2.714		
000259	2.821	2.927	3.038	3.150	3.265	3.384_	3.506	3 • 632		
000250	3.763	3.697	4.033	4.172	4.309	4.445	4.577	4.704		• * *
	4.822	4.935	5.041	5.141	5.236	5.325	5.410	5.490		
000261 006262	5.567	5.642								
	27.4500	28.8000	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000		
000263	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52,2000	54.0000		
090264	55.8000	57.6000	59.4000	61.2000	63.0000	64.8000	66.6000	68.4000		
000265			73.8000	75.6000	77.4000	79.2000	81.0000	82.8000		
~000266	70.2000	72.0000		90.0000	91.8000	93.6000	95.4000	97.2000		
000267	84.6000	86.4000	88.2000	90.0000	47.000	93.0000	, 3 • 10 00			
000268	99.0000	100.6000		0.00477	0.20391	0.21106	0.21344	0.21591		
000269	0.20168	0.20303	0.20486	0.20677		0.23506	0.23919	0.24364		
000270	0.21861	0.22139	0.22449	0.22775	0.23124	0.23500	0.29021	0.30022	*	
000271	0.24849	0.25381	0.25969	0.26613_	0.27336_	0.38978	0.40981	0.43102		
000272	0.31151	0.32406	0.33821	0.35386	0.37103		0.58996	0.61237		
000273	0.45304	0.47561	0.49849	0.52154	0.54:50	0.56731	0.500.50	0.01237		*
000274	0.63454	0.65639			محروبي والراز والمستسيد			-84.56		
000275	-107.13	-104.99	-101.99	-98.83	-95.52	-92.03	-88.40	-47.36	. √	
000276	-80.59	-76.43	- 72•08	-67.56	-62.83	-57.90	-52.74 -2.06	5.73		
000277	-41.76	-35.89_	-29.75	-23.33	<u>~16.59</u>	<u>-9.51</u>		79.51		
000278	13.92	22.50	31.43	40.71	50.22	59.93	69.72	150.46		
000279	89.17	98.68	107.94	116.96	125.70	134.19	142.44	150.46		
000280	158.27	165.99						4 300		
600281	1.209	1.286	1.387	1.487	1.587	1.686	1.785	1.884	•	
000282	1.982	2.080	2.179	2.277	2.376	2.476	2.577	2.677	•	•
000283	2.780	2.884	2.988	3.094	3.204	3.315	3.427	3.544		
000284	3.601	3.782	3.905	4.028	4.153	4.277	4.399	4.519		
000284	4.635	4.746	4.852	4.954	5.950	5.141	5.229	5.311		
000286	5.391	5.469								
	27.7235	28.8000	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000	•	
000237	41.4000	43.2000	45.0000	46.8000	48.6900	50.4000	52.2000	54.0000		a
00u288	55.8000	57.6000	59.4000	61.2000	63.0000	64.8000	66.6000	68.4000		-
000239	70.2000	72.0000	73.8000	75.6000	77.4000	79.2000	81.0000	82.8000		
000290	84.6000	86.4900	0003.88	90.0000	91.8000	93.6000	95.4000	97.2000		
000291		100.8000	00.000	,						
000292	99.0000		0.20391	0.20574	0.20772	0.20987	0.21217	0.21456		
000293	0.20105	0.20208		0.22576	0.22910	0.23267	0.23649	0.24062	_	
090204	0.21710	0.21980	0.22266	0.26006	0.26732	0.27424	0.28186	0.29037		
<u> </u>	0.24507	0.24992	0.25524	0 * 44300 0 * 50000	0.34758	0.36436	0.37834	0.39526		

West Sa

	TAD:428249	,2,100 ,					DATE US AF	PR 72 PAGE	8		- The State of the	
000297	0.41298	0.43159	0.45057	0.46996	0.48959	0.50938	0.52909	0.54879				
000298	0.56834	0.58781										
000299	-104.33	-102.63	-99.64	-96.50	-93.22	- 89 .7 9	-86.18	-82.41				
000300	/ -78.46	-74.37	-70.10	-65.64	-60.99	-56.17	-51.14	, - 45.89				
000301	-40.45	-34.78	-28.87	-22.71	-16.27	-9.55	-2.55	4.75				
000302	12.37	20.28	28.51	37.00	85.74	54.70	63.79	72.98				
000303	82.17	21.30	100.34	109.24	117.96	126.49	134.83	142,96				
000304	150.91	158.80	20000	207712								
00.0305	1.213	1.272	1.373	1.472	1.571	1.669	1.767	1.865				
000306	1.962	2.059	2.155	2.252	2.349	2.448	2.546	2.644			•	
	2.744	2.843	2.944	3.047	3.150	3.256	3.362	3.470				
000307		3.692	3.804	3.918	4.033	4.147	4.260	4.373				
000308	3.580				4.888	4.981	5.069	5.154				
000309	4.482	4.590 .	4.693	4.792	9 • 000	4.701	3*009	J • 1 .7·*				,
000310	5.234_	5.314			70.000	74 0000	77 0000	39.6000				
000311	28.2617	28.8000	30.6000	32.4000	34,2000	36.0000	37.8000	54.0000				
000312,	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52.2000				T .	
000313	55.8000_	57.6000	59.4000	61.2000	<u>_63,0000</u>	<u>64.8000</u>	66.6000	68.4nno				
000314	70.2000	72.0000	73.8000	75.6000	77.4000	79.2000	81.0000	82.8000			4	
000315	84.6000	86.4000	88.2000	90.0000	91.8000	93.6000	95.4000	97.2000			1	
000316	99.0000	100.8000										
000317	0.19985	0.20033	0.20200	0.20383	0.20566	0.20764	0.20971	0.21193				
000318	0.21432	0.21678	0.21940	0.22218	0.22520	0.22838	0.23172	.0.23538				
000319	0.23919	0.24332	0.24777	0.25262	0.25771	0.26335	0.26931	0.27582				
000320	0.28290	0.29053	0.29879	0.30769	0.31731	0.32764	0.33860	0.35029				1
000321	0.36268	0.37564	0.38914	0.40313	0.41759	0.43230	0.44724	0.46241		•		
000322	0.47767	0.49309	0,000,21									
	-98.72	-97.87	-94.95	-91.88	-B8.63	-85.24	-81.70	-78.03		7		
000323			-66.01	-61.70	-57.20	-52.55	-47.71	-42.69				
000324	-74.17	-70.19	-26.55	-20.77	-14.71	-8.59	-2.17	4.45	•			
0.10325	-37.51	-32.11			40.90	48.79	56.83	65.00				
0.303336	11.30	18.38	25.70	33.20				131.14				
000527	73.28	81.60	89.96	98.32	106.63	114.91	123.08	101.14				
0.00758	139.10	147.05										
000329	1.218	1.247	1.346	1.444	1.541	1.637	1.733	1.829	1			
090330	1.924	2.019	2.112	2.207	2.301	2.395	2.489	, 2.584				
000331	2.679	2.773	2.868	2.964	3.060_	3.157	3.256_	3.354				
000332	3.452	3.552	3.653	3.752	3.853	3.954	4.054	4 • 155	A 44 A 4			
000333	4.253	4.351	4.446	4.540	4.633	4.721	4.808	4.891			•	
000334	4.973	5.052										
- 000335	28.7910	28.8000	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000				
0003336	41.4000	43.2000	45.0000	46.8000	48.6000	50.4000	52,2000	54.0000	*			
000334	55.8000	57.6000	59.4000	61.2000	63.0000	64.8000	66.6000	68.4000				
000337	70.2000	72.0000	73.8000	75.6000	77.4000	79.2000	81.0000					
000339	84.6000	86.4000	88.2000	90.0000	91.8000	93.6000	95,4000	.97.2000				
000339	99.0000	100.8000	00.000	20.0000								
		0.19874	0.20033	0.20200	0.20375	0.20558	0.20756	0.20963				
000341	0.19874	0.21408	0.21646	0.21909	0.22179	0.22465	0.22767	0.23085				
000342	0.21177			0.24595	0.25032	0.25500	0.26001	0.26534				
000343	0.23434	0.23792	0.24181				0.31429	0.32311				
000344	0.27100	0.27718	0.28369	0.29069	0.20908	0.30594		0.40853				
000345	0.33241	0.34218	0.35235	0.36298	0.37389	0.38517	0.39669	0.40853				
000346	0.42061	0.43277		سنج والماري واستسبيت								
600347	-93.13	-93.11	-90.26	-87.21	-84.03	-80.70	-77.22	-73.60				
000348	-69.82	-65.92	-61.85	-57.64	-53.27	-48.75	-44.06	-39.24		1		
000249	-34.23	-29.07	-23.73	-18.23	-12.58	-6.71	-0.70	5.50			125	
0.00350	11.87	18.42	25.14	32.03	39.09	46.30	53.63	61.10				
000351	68.69	76.35	84.09	91.88	99.70	107.53	115.34	123.12	٠.			
000352	130.86	138.67		***				*				
000353	1.224	1.224	1.321	1.417	1.513	1.607	1.702	1.796				
000353 000354	1.888	1.981	2.073	2.166	2.257	2.348	2.439	2.530				
りりひょうか												
346355	2.622	2.713	2.884	2.594	2•98 7	3.078	3.169	3.262				

	TAD+4282491	2,100					DATE 05 AF	PR 72 PAGE	9
000357	4.087	4.178	4.266	4.354	4.439	4.524	4.606	4.687	
000358	/ 4.766	4.845							
000359	29.3093	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000	41.4000	
00036 0 .	/43.2600	45.0000	46.8000	48.6000	50.4000	52.2000	54.0000	55.8000	
000361	/ 57.6000	59.4000	61.2000	63.0000	64.8000	66.6000	68.4000	70.2000	
000362	72.0000	73.8000	75.6000	77.4000	79.2000	81.0000	82,8000	84.6000	**
000363	86.4000	88.2000	90.0000	91.8000	93.6000	95,4000	97.2000	99.0000	
000354	100.8000								
000355	0.19763	0.19855	0.20025	0.20192	0.20367	0.20550	0.20748	0.20947	
000366	0.21162	0.21384	0.21622	0.21869	0.22131	0.22409	0.22703	0.23013	•
00036 7	0.23339	0.23681	0.24046	0.54458	0.24833	0.25262	0.25723_	0.26208	
000368	0.26716	0.27257	0.27837	0.28441	0.29076	0.29752	0.30459	0.31198	
000369	0.31969	0.32780	0.33614	0.34488	0.35386	0.36308	0.37254	0.38223	
000370	0.39216								
0003/1	-87.59	-85.54	-82.56	-79.42	-76 • 14	-72•72	-69·16	(~65.45	¥ .
000372	-61.61	-57.62	-53.51	-49.24	-44.83	-40.09	- 35.57	`-30.73	i
000373 /	-25.74	-20.60	-15.31	-9.87	-4.28	1.45	7.33	13.37	
000374	19.55	25.89	32.35	· 38•96	45.68	52.55	59.52 118.00	66.60 125.45	i
000375	73.77	81.02	88•34	95.72	103.12	110.56	118400	160+40	
000376 000377	133.00 1.228	1.297	1.392	1.487	1.579	1.673	1.765	1.856	
090378	1.946	2.038	2.126	2.216	2.305	2.394	2.483	2.571	•
090378	2.658	2.747	2.835	2.923	3.089	3.097	3.185	3.271	
030380	3.359	3.445	3.532	3.618	3.704	3.790	3.875	3.959	
000331	4.044	4.127	4.208	4.290	4.369	4.449	4.526	4.602	
000332	4.678	, - 4 ,	7 4 2 7 6	1 - 1 / /	(• ()	, .	1 4 412 (3		
000383	29.8137	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000	41.4000	
000334	43.2000	45.0000	46.8000	48.6000	50,4000	52.2000	54.0000	55.8000	
63335	57,6000	59,4000	61.2000	63.0000	64.8000	66,6000	68,4000	70.2000	•
Chr. Lan	72. jidin	73. abaa	75. (dun)	77.4000	79.2660	81,0000	82,8000	84.6000	
ยายรับรั	86.4000	89.2900	ԾՄ. Ծ։ ՄՄ	et compil	ძკ.გოთ	ង្គ. មួយព	97.800d	թց. Ուայց	
000388	100.0000	O17 + ₩ 7 € O	30.00	y (• 1144944		3 14 1 7 3 9		"	
000389	0.19660	0.19715	0.19866	0.20025	0,20192	0.20367	0.20542	0.20732	
000390	0.20939	0.21146	0.21368	0.21599	0.21837	0.22091	0.22362	0.22640	
000391	0.22934	0.23252	0.23577	0.23919	0.24277	0.24658	0.25055	0.25477	
000392	0.25922	0.26390	0.26875	0.27392	0.27924	0.28488	0.29084	0.29696	
000393	0.30340	0.31008	0.31699	0.32414	0.33153	0.33916	0.34695	0.35497	
000394	0.36316						· ·		
000395	-82.09	-80.85	-77.91	-74.81	-71.57	-68.20	-64.68	-61.04	
000396	-57.26	-53.36	-49.31	-45.15	-40.82	36.38	-31.80	-27.06	.7.
000397	-22.22	-17.23	-12.11	-6.84	-1.47	4.05	9.70_		the state of the s
000398	21.41	27.42	33.59	39.86	46.26	52.76		66.07	
000399	72.85	79.74.	86•67	93.69	100.75	107.85	114.97	122.14	
000400	129.41								
000401	1,234	1.274	1.368	1.462	1.553	1.645	1.735	1 • 825	
000402	1.914	2.003	2.092	2.180	2.866	2.353	2.439	2 • 526	
000403	2.611	2.696_	2.782	2 • 866_	2.950	3.034	3.118	3.201	
000404	3.284	3.367	3.450	3.532	3.613	3.694	3,776	3 • 855	•
000405	3.935	4.014	4.092	4.169	4.245	4.320	4.394	4.468	
000406	4.540	30 / 000	*****	30.000	76 0000	77 0000	30 (000	# # # DOO	
000407	30.3191	30.6000	32.4000	34.2000	36.0000	37.8000	39.6000	41.4800	*
000408	43.2000	45.0000	46.8000	48.6000	50.4000	52.2000	54.0000	55.8000 70.2000	
000409	57.6000	59.4000	61.2000	63.0000_	64.8000	66.6000	68.4000_	70.2000	
000410	72.0000	73.3000	75.6000	77.4000	79.2000	81.0000	82.8000	84.6000	
000411	86.4000	89.2000	90,0000	91,8000	93,6600	95.4000	97.2000	99.0000	
000412	100.3000	n 10san	0.19715	0.19866	0.20025	0.20192	0.20359	0.20542	
000413	0.19556	0.19580				0.20192	0.22060		•
000414	0.20732 0.22584	0.20923	0.21130 0.23169	0.21344 0.23474	0.21575 0.23100	0.24142	0.54400	0.22314 0.24873	

Philippine Committee Commi	៩៥៥៤៤ • ៤	05401°0 _	965-4*6	19861*0	90,01°0	60 (n [*0	91 (05 (* 0	91051*0	925080
The second secon		10008-001	0000166	0006.76	00011*56	0009*sb	0000116	0000.00	97,4000
	98*\$000	0008 001	0000-48	85*4000	0000*18	\$6*5000	0000.77	0009*52	t-/ ti000
ve.	0008.87	72,0000	70.2000	0065*89	0000 • 99	0008*69	93*0000	0000*19	999917
ا میں استفاد اور موروس میں استفاد کی استفاد اور		0000 62	0003*55	0000 175	95,2000	0009*69	6009*106	0000-96	67 9000
	00011.05			0009*6 %	0008.7 £	20*0000	20.2000	897.1488	17,0000
	0000*5#	0002°£h	0006-16		\$48.5	777.E	3,712	G44.6	074000
and the second s	Z60 • 11	\$20 th	076.E.	900°E				260.5	694000
•	040.8	517.5	⊊ម្ មុ	74 E	302.5	368.8	9.1043	\$500 ×	894000
' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '	150.5	640.5	278.S	S•908	757.5	189.5	978+3		
	2.1193		2.266				_S#6 • I		994000
	087.t	969•1	1.612	1.527	Ohh•T	\$2£*T	1.265	1.258	594000
	128.28	151.95	87.211	119.601	69 ° £ 0 T	SS • 76	09.16	69.88	
the state of the s	78.07	11.47	S4.89	87.59	57.72	94.12	#8.04		<u> </u>
	84.25	1900€	78 • 82	86.05	19°51	78.01	91.4	55 ° 1	504000
	96°2-	75.T-	89.11-	88.7-	86•6 1-	76.5S-	28.YS-	09.15-	294000
·	_35.27	18.85-	-45.22	99.94-	EL.84-	87.12-	0/		194000
	19066.0	15385.0	0.28218	0.27813	0.27416	0.27026	6.26653	76233.	0.000,000
	0.25730	0.25580	94555.0	0.24912	96942.0	0.84285	1,985591	79352.0	694000
	. 8146S.O.	0.23148	0.22886	0.225532	0.22385	0.22147	0.21916	S0715.0	854000
		0.21281	0.21082	16808.0	10705.0	0.20526	12503.0	0.20184	Z\$1:000
		77891.0	15791.0	88792.0	511161.0	81261.0	16161.0	£8161.0	994000
	0.0050		97.2000	00uh*Só	0009.56	_0008 16	U000 06	88.2000	994000
				0000.18	79,2000	0000 10	0000.57	73.8000	656000
	000th. 98	0009*#8	82.8000	0069*99	0008 49	0000.59	61,2000	0000 22	£5±000
	72,0000	. 70.2000 ·	0004.89		0000119	0000 £5	0008*9#	0000°Sh	224000
	0009.72	0008.22	0000 • 45	52,2000		34.2000	32,4000	32.24b7	194000
	43.2000	0004.14	0009•6€	37.8000	0000 92		928+5	007.c	094000
	042.4	カイよ。カ	80T * # .	Thu to	476.€	S06*£		781.8	655000
	969 <u>*</u> £	ZS3.5	 59.*£		80#.E	G8.8	_34262		855000
	111.5	9£0*£	5*626	2,082	\$ 805	7.727	669*3	078,5	7 p ti 0 C 0
	5*#60	2°#10	8,329	7#8.S	491.5	2,083	806.1	1/16*T	966000
	1.830			1772	1.4198	£65.1	1.304	942.1	
•	T10.051	48.011	112.35	16.901	100.54	94.20	₹6.T8	SV.18	S115000
•	89*54	ZS*69	£8.58	09:45	87.12	40·9h	6 2° 0†	\$8.4€	11111000
	56.34	79.55	89.81	T3°2U	0n•8	Σ 1) • Σ	<u></u>		chh000
	68.01-	94.51-	68.91-	25 ° ti 2−	54.85 -	-28.52	13.05-	<u> የ</u> ፎ•ዐክ−	6000445
	01.444-	2L.74-	SS • 18-	29° 45-	98.72-	70.0d -	96°£9 ~	T.4.*99-	144000
	0.31111	98902.0	04002*0	6956600	0.29076	0.28600	<u> </u>	87375.0	0.0000
	0.27241	0.2692.0	0.26406	60092.0	0.25628	D.25254	70845.0°	999#2*0	000#28
•	0.24221	0.23903	0.23601	0.23299	0.23021	0.22743	.0.22481	0.22226	85#000
	0.21988	0.21750	75215.0	0.21313	0.21106	40602.0	0.20717	#£202*0	
	88616.0	0.20184	25005-0	99061.0	6.19723	08901.0	99861.0	99861.0	. 95,4000
		0000*66	97.2000	0007196	0009.59	0008*16	0000.06	98.2000	SCHARO
	100.8400		0000.58	0000.38	79.2000	0000.77	U009*SZ	0008.57	924000
	0004.38	0009*#8	Address of the control of the contro		0008 52	0000.53	0002.19	0000 69	554000
	72,0000	70.2000	0000.45	0009.99	000h*0S	0008+84	0008*9#	0000*5#	000432,
	0009.72	0008.88	20000	25.5000				5862 *12	154000
	43.2000	_000h•Th_	0009 <u>•6£</u>	<u> </u>	0000.35	34.2000	32.4000	SSu. p	000000
•					11000	h/ : 10	. 616.60		000000
	115ۥ11	4.284	4.213	Th: th	7.80 • p	ხ6 6 • ⊊	616.5	£48.5	
	69L • £	\$69.5	519.5	988•8	984.E	675.E	2,209	3.220	854000
	1411.5	3.060	870.5	798.S	2.815	2.733	059.5	792.5	. 7S#000
	t1811 € C	S•000	2.315	2.231	ちゃてかけ	5*028	1.972	S98 ° ₹	924000
•	L6L•1	807.1	1.618	1.528	<u>፲</u> ዮክ•፲	945•1	1.253		000#S2
								127.39	000 <i>0</i> 50
	150.35	313°t6	69.901	LL "66	65.99	6S • 88	£9*6Z	90 • 67	0,000
	99 199	pr.09	£8•£5	09"41	8n • I ti	71. Th	29.65	23.73	900d32
		12.45	66 • 9	±19°1	88.5-	07.8-	69.81-	96.81-	124000
	42.65~ ,	98.75-	78.38-	#Z*9£-	46.04-	80 • Sh=	90.°6h=	76°25- /	024000
	, ~23.29		89.59-	10-76-	12.07-	-73.26	91.94-	19.94-	614000
	29.95-	-60.20	07 27	10 43-	<u> </u>			94746	810000
•			7777040	004.70.50	*****	1020013	0*59646	0.29084	214000
	55#2£•0	0.52780	0.32112	0.31468	14802.0	75S02.0	0.0200		
		·					00147	140,428249	Approximation of the control of the second o
U I	PAR ST PAGE	DATE OS AF	ı				. 001.6	- O 0 C O C 10 - C/A T	

	TAD: 428249	2,100 .					DATE 05 AP	P 72 PAGE			
			0.00751	0.00510	0.00/.07	0.20875	0.21058	0.21249			.,-
000477	0.20033	0.20192	0.20351	0.20518	0.20693 0.22898	0.22528	0.22767	0.23013			
000478	0.21448	0.21646	0.21861	0.22075	0.24340	0.24626	0.24920	0.25222			
000479	0.23259	0.23522	0.23784	0.24062			0.27551	0.2366			
000480	/0.25532	0.25850	0.26176	0.26510	0.26851	0.27193 -29.88	+26.40	-22.84			
000481	-44.27	-42.61	-39.62	-36.49	-33, 25		5.14	9.53			
000482	-19.15	-15.35	-11.45	-7.46	-3.34	0.85	42.76	47.81			
090433	14.01	18.59	23.26	28.02	32.84	37.77	85.22	90.83			
000484	52.95	58 • 16	63.42	68 • 78	74-20	79.68	131.76	200113			
000435	96.50	102.22	108.00	113.84	119-73	125.66	1.735	1.816			
000486	1.266	1.316	1.401	1.485	1.570	1.652	2.362	2.437			
09048 7 .	1.897	1.976	2.054	2 • 132	2.209	2.286		3.013			
000488	2.512	2.585	2.658	2.731	2.803	2.373	2.944				
000489	3.081	3.150	3.218	3.284	3.350	3.416	3.481	3.545	+ 1		
000490	3.609	3.672	3.734	3.796	3.856	3.917	3.978				-
000491	34.0793	34.2000	36.0000	37.8000	39.600	41.4000	43.2000	45.0000			
000492	46.8000	48.6000	50.4000	52.2000	54.0000	55.8000	57.6000	59.4000			
000493	61,2000	63.0000	64.8000	66.6000	68.4000	70.2000	72.0000	73.8000			
000494	75.6000	77.4000	79.2000	81.0000	82.8000	84.6000	86.4000	88.2000		· /	
000495	90.0000	91.8000	93.6000	95.4000	97.2000	99.0000	100.8000				
000496 -	0.18857	0.18865	0.18976	0.19095	0.19215	0.19342	0.19469	0.19604		<u> </u>	
000493	0.19747	0.19390	0.20041	0.20192	0.20351	0.20518	0.20685	0.20860			
000498	0.21034	0.21217	0.21408	0.21599	0.21805	0.22012	0.22218	.0.22433			
000499	0.22656	0.22886	0.23124	0.23363	0.23609	0.23855	0.24118	0.24380			
	0.24650	0.24920	0.25206	0.25493	0.25787	0.26081	0.26383			•	
000500	-33.69	-33.48	-30.54	-27.47	-24.27	-20.96	-17.55	-14.03			
000501		-6.69	-2.87	1.04	5.05	9.17	13.37	17.65			
000502	-10.40_		31.07	35.70	40.41	45.19	50.05	54.98		,	
000503	22.05	26.51			80.59	85.90	91.28	96.72	` ·	•	
000504	59.97	65.02	70.14	75.35 118.98	124.70	130.44	136.34	/	•		
000505	102.20	107.74	113.35			1.612	1.693	1.773			
000506	1.276	1.280	1.365	1.449	1.530			2.381			
000507	1.852	1.930	2.007	2.084	2.160	2.234	2.308			*	
000508	2.455_	2.526	2.597_	2.668	2.738	2.307_	2.875	2.943			
000209	3.009	3.076	3.141	3.206	3.270	3.334	. 3.397	3+458			
000510	3.520	3.581	3.642	3.701	3.760	3.820	3.879				
000511	34.9613	36.0000	37.8000	39.6000	41.4000	43.2000	45.0000	46.8000			
000512	48.6000	50.4000	52.2000	54.0000	55.8000	57.6000	59.4000	61.2000			
000513	63.0000	64.6000	66.6000	68.4000	70.2000	72.0000	73.8000	75.6000			•
000514	77.4000	79.2000	81.0000	82.8000_	84.6000	86•4000_	88.2000	90.0000			
000515	91,8000	93.6000	95.4000	97.2000	99.0000	100.8000		•	3		
000516	0.18706	0.18770	0.18881	0.18992	0.19111	0.19231	0.19358	0.19485			
000517	0.19620	0.19755	0.19898	0.20049	0.19605	0.20351	0.20510	0.20669			
000518	0.20844	0.21011	0.21193	0.21368	0.21559	0.21750	0.21940	0.22147			
000519	0.22346	0.22560	0.22775	0.22989	0.23212	0.23442	0.23681	0.23919			
000520	0.24157	0.24404	0.24658	0.24920	0.25183	0.25445				·	
000521	-23.18	-21.49	-18.47	-15.31	-12.05	-8.70	- 5.22	-1.66			
000522	1.98	5.73	9.59	13.52	17.55	21.69	25.89	30.17		•	
000523	34.57	39.03	43.55	48.15	52.85	57.58	62.40	67.28			
000524	72.21	77.20	82.28	87.40	92.58	97.81	103.09	108.45			
	113.84	119.30	124.81	130.35	135.94	141.70					
000525 000526	1.284	1.331	1.413	1.495	1.575	1.655	1.733	1.811			
		1.963	2.039	2.112	2.186	2.259	2.330	2.401			
000527	1.887 2.472	2.542	2.611	2.680	2.747	2.814	2.880	2.945			
000528		2.542 3.073	3.136	3.200	3.262	3.322	3.384	3.443			•
000529	3.009		3.619		3.734	3.792		~_~~~			
000530	3.502	3.561		3.677 6 -2.1059		3.8373024g	-06 -0.77	32374E-06	* . *		
000531	-8.037731		2281445E-0			6.5248416E		112215-05			
000532	-1.525941		6335328E-0			2.59223356		73105E-04			
000533 -000534	-1.318050		7020696E+0 2257714E+0			Z•59223056 5•05273056		521585 04		/Ga	_
	-3.639723										

	-1.1803709E-03 -4.0351868E-03 -2.9235301E-03	-0.05678275-03 -0.0567875-03 -0.0678495-03	-2,6272401E-03 -5,4292715E-03 -6,2069722E-03	-2*#122872-03 -2*#132869E-03 -2*#177387E-03	-2*50520408E-02 -2*57434422E-02	0002#1 0002#1 0002#1
	-5.0124586E-02 -1.1015059E-02	-1.7400006E-03	-0.1273819E-02	-1.5A86189E-02	-7.1959132E-02 -1.1959132E-02	<u></u>
	-2.6986842E-02	6.1201507E-03 -2.1131850E-02	-8.3672208E-04	-1.1157932E-02 -2.3006439E-02	-2.2297747E-03 -7.2297747E-03	Z#9000 9#9000
	\$*\$0212#1E=01	1.7331713E-01 6.8570651E-02	#*ISVS0067E-02	8*2#12082E-0S	#*187111E-02 -2*5967306E-01	649000 849000
	#.8814042E-01	#*\$889084E-01			2*99724-01 5*99724-01	099900
t = t	1.1918611E+00 1.5657673E+00	I.1158471E+00	T*0262281E+00	4.6869537E-01	8.93163232-01	000552 7,22000 7,22000
ļ	1,9056878E+00	1.8403562E+00	1.7737101E+00 1.4195863E+00	1.7064442E+00	1*9298832E+00 1*S980118E+00	#55000 5 55000
1	\$*8050002E+00 \$*\$645860E+00	\$*\$4020#5E+00 \$*1898081E+00	\$*28#1538E+00 5*1101051E+00	5*#23321E+00 5*0230#11E+00	\$*\$290292+00 \$*\$A\$7995E+00	954000 954000
	#*5022509E+00 2*2156862E+00	2*3623746E+00	2*31#353#E+00 2*31#353#E+00	2*81\$\$208E+00 2*0\12882E+00	\$*6235574E+00 \$*6235574E+00	
	2*1#85105E+00	# 46617539E+00	4.8109301F+00	# 6326102E+00	#*#2\S022E+00	699000 999000
	1.2091781E+00 6.1196071E+00	1.5845818E+00 2.067975E+00	\.0008335E+00 2*0008335E+00	0*1529722E+00 2*2392035E+00	6,495882E+00	T99000 099000
1	1.1241795E+01		8.3571042E+00 1.0229200E+01		7.7575489E+00	299000
	1.1833711E+01	1°550265#E+01	1.2275667E+01	1.2016333E+01	7°1340486E+07	£99900 699900
	T*#d80#11E+U1		0*9171715E+0)		10+34076411.1	999000
	-1 *##26882€+00	-8.8737394E-01	-#************************************	T0-30202008*[-	\$.74065CH8+01	$\chi_{\alpha_1 \alpha_2 \alpha_3 \alpha_4}$ $\alpha_{\alpha_1 \alpha_2 \alpha_3 \alpha_4}$
	-1.7982500E+00 -7.0653454E+00	T*E+0T_ R*#A22221E+UO</td><td>-1,40968010E+01 -1,40968010E+01</td><td>3.0135138E+00.</td><td>-5.1300185E+00</td><td>896009</td></tr><tr><td></td><td>-2.1270310E+01</td><td>-S*8012S0E+01</td><td>-5.5827529E+01</td><td>-5°2404809E+01</td><td>-8*0040711E+01 -8*0040711E+00</td><td>045000 695000</td></tr><tr><td></td><td>-d.7185354E+01 -d.252120E+01</td><td>-4.6823811E+01</td><td>-3.8676869E+01 -4.6171278E+01</td><td>-2*6212965E+01</td><td>-2*2568301E+01</td><td>T/25000</td></tr><tr><td></td><td>TU+35003856•ħ━</td><td>-d.8607001E+01</td><td>-# 10001765E+n1</td><td>10+34058094.4-</td><td>-d*400820C+01</td><td>000673 000673</td></tr><tr><td></td><td>-0*###2172E+01 -6*232962E+01</td><td>-5.6727770E+01</td><td></td><td>1.0108205E+01_ _2.2068125E+01</td><td></td><td>47.9000</td></tr><tr><td></td><td>-1.0598185E+02</td><td>-1*0508813E+0S</td><td>10+324787476-01</td><td>-u*3500P00E+01</td><td>10+30999889</td><td>972900 672900</td></tr><tr><td></td><td>-1.3730741E+02 ·</td><td>-1.3843027E+02</td><td>-1.30311578+02 -1.30311578+02</td><td>-1.3032205E+02 -1.3032205E+02</td><td>-1.8737635E+02 -1.8737635E+02</td><td><u>, 8</u>29000 229000</td></tr><tr><td>: · · · .</td><td>₩1.6426362E+02</td><td>-1.6366492E+02</td><td>-1 *2004047E+02</td><td>-1.5333181F+02</td><td>-1 *2045102E+02</td><td>645000</td></tr><tr><td></td><td>-1.7825786E+02 -1.7825786E+02</td><td>-1.7159915E+02</td><td>-1.9410329E+02 -1.9410329E+02</td><td>1.8864278E+02 1.88642E+02</td><td></td><td>000287<u> </u></td></tr><tr><td>•</td><td>-1.4498536E+02</td><td>-1.7942589E+02</td><td>-5.0118944E+02</td><td>-5 00058356E+05</td><td>-S*120#047E+02</td><td>006285</td></tr><tr><td></td><td>T_02SB2\$\$\$E+0\$ ~T*22\$#248E+0\$</td><td></td><td></td><td><u>-0,7440413E+01</u></td><td>_6*PST2224E+05</td><td>0.0028# 0.0028\$</td></tr><tr><td></td><td>-S.6094543E+00</td><td>-3.2165717E+00</td><td>-2.0682478E+60</td><td>-S*3258299E+00</td><td>-2.46529716-01</td><td>989000</td></tr><tr><td></td><td></td><td>2.5378825E+n1</td><td>1.13426128+01</td><td>3,2160865E+00</td><td>-1.2407244E+00</td><td>აგგვიგგ</td></tr><tr><td></td><td>2*1\01281E+0S 1*8022201E+0S</td><td>2*0012152E+05</td><td></td><td>\$*P\$\$T61PE+US 6*P1PTP2UE+UT</td><td>5.2540165E+01 2.2540165E+01</td><td>889900 28900</td></tr><tr><td>V:</td><td>5.4109665E+02</td><td>\$.8602308E+02</td><td>2*15#8279E+02</td><td>3.23/3676E+02</td><td>3.2576079E+02</td><td>000289</td></tr><tr><td></td><td>-8.2083220E+02 -8.7793619E+02</td><td></td><td></td><td></td><td>1.8287156+02</td><td>069000</td></tr><tr><td></td><td>-1*1896026E+03</td><td>20+38448991*1- 20+38448991*1-</td><td>-6.3011102E+07 -1.1236298F+03</td><td>-##*0426502C+02 -##*0426602C+03</td><td>20+39957794*6- 20+39957794*6-</td><td>ᲘᲘᲜᲛᲐᲕ ᲘᲔᲘᲛᲐᲨ</td></tr><tr><td>The second secon</td><td>-1.11809238+03</td><td>I*T#S1282E+Q2</td><td>~-1.1663516F+03°</td><td>1 *18017136E+02.</td><td>£0+35028961*1-</td><td>00(£62</td></tr><tr><td></td><td>-1*96534855+03 -1*96611690+1-</td><td>-1.0264770E+03</td><td>-1.0857575901# -1.084901886463</td><td>20+3th16650*1- 20+3th189511*1-</td><td>- \$0+B8998891*1- - \$0+B8888\$\$\$1-</td><td>Գանկան Ֆոլեսյին</td></tr></tbody></table>				

	TAD:428249:2:100 ,		DA [*]	TE 05 APR 72 PAGE	13		
000597	-7.3317710C+02 -7.1729678E+0	2 -6.1916306E+ 02	-5.2271128E+02	-5.3825987E+02			
000598	-5.1531466E+02 -5.1639302E+0			-1.8416297E+02			
000599	-8.7846858E+01 1.5419294E+0			8.7722455E+02			
	* T T T T T T T T T T T T T T T T T T T			5.4030442E+02			
003000				1.9715175E+03			
000601	/			0.0E+00			
000002	1.5643871E+04 0.0E+0			-8.6642049E+01			
000603	1.0761355E+00 9.0125519E+0		and the second s	-1.0446450E+03			
000604	-1.5703564E+02 -2.7513041E+6			-3.3410802E+03			
ขึ้นแอยี่5	-1.4487078E+03 -1.8692702E+0			-5.0390446E+03			
00006 0 6	-3.8559030E+03 -4.3843916E+0						
000007	-5.0769555E+03 -4.9279847E+0	A 11		3.2393895E+03_			
000008	-2.1710548E+03 -8.3495872E+0			4.7142330E+03			
000609	6.9491255E+03 9.2604127E+0	•		1.5672403E+04			
000610	1.7362219E+04 1.8840761E+0			2.1205585E+04_			
000611	2.1388423E+04 2.1278368E+6	4 2.0977596E+04		2.0065p04E+04			
000612	2.0212248E+04 1.9492025E+6	14 1+8829911E+04	1.8237987E+04	1.7749108E+04		<i>i</i>	
000613	1.7442580E+04 1.6669838E+0	4 1.5978421E+04	1.5412988E+04	1.5529079E+04			
000614	1.4476561E+04 1.3941732E+0	4 1.43400215+04	1.2070660E+04	1.2720182E+04		1	
000615	9.0641995E+03 8.6428251E+0	3 7.4271301E+0"	6.3105084E+03	6+3673451E+03 (1	
000616-	6.07089325+03 6.05328025+0		4.9320575E+03	3.5624987E+03			
090617	2.9059444E+03 1.1351017E+0			-3.8552011E+03			
090618	-5.4197643E+03 -5.4462613E+0		and the second s	-9.1656659E+02			
000619	2.7670921E+03 2.0174573E+0			-9.3307466E+03	•		
000619	-9.3572403E+04 0.0E+0	A COMPANY OF THE PART OF THE P	and the second of the second of the second	0.0F+00		•	
	0.0005 0.0010 0.0015 0.00			0.0045 0.0050	•		
000621	* - * - *					•	
000622	the second state of the se			- Comment of the Comm		,	
000623				0.0195 0.0200			
000624	0.0155 0.0160 0.0165 0.01				•	_	
0000625	0.0205 0.0210 0.0215 0.02		markets.	water transfer to the same of			
60000,26	0.0255 0.0250 0.0265 0.02					•	
0000627	70.0305 0.0310 0.0315 0.03						
65000	0.0355_0.0360_0.0365_0.03		0.0385_0.0390	Annual Contract Contr			
000629			0.0435 0.0440				
000630	-0.73234603E-02 -0.44	, , The 17 Ann 19 O	66207946E-03	-0.29226363E-03	•		
000631	0.40084907E-04	0.0E+00	0.05+00	0.0E+00			
000632	-0.27176666E+02 0.21	L29340E+03 0	13364318E+02	-0.19311670E+04			
000633	0.67461013E+04	0.0E+00	0.0E+00	0.0E+00			•
000634	-0.719677245-02 0.14	+95527E-020	32403130E-02	-0.44640177E-02			
000635	U.U€+00	0.0E+00	0 • 0E+00	. 0.0E+00	Ş		
000636	0.17724540E+01 -0.44	368890E+02 0-	20554680E-01	0.05+00	Y'.		
000637	0.06+00	0.05+00	0.0E+00	. n.oE+00			
000038		097080E+02 0	.10044000E+01	.0.17484950E-01			
000639	0.0E+00	0.05+00	0.0E+00	-0 • 0E+00			
000540			.09787200E+01	0.00271270E+01			
000641	0.02+00	0.0E+00	0.0E+00	. 0.0E+00			
000642			.25312000E+01	-0.00666590E+01	•		
	0.000000	0.0E+00	0.0E+00	0.NE+n0			
000643			.02737800E+01	0.58282000E-02			
000644		10000E-01	0.0E+00	0.0E+00			
000645			.00378920E+01	0.40527000E+02			
000646			.01769100E+01	0.00641000E+01			
. 000647	0.54573000E+01 -0.32	けつひいけしにキひょ 一サリ	● ロステロウエリリにエリス	JUGOGTICHOLINA,			
* 000047							

- -

Luci Mi

****	uant and the second sec	:IFE S (EMO*E0*0) 00 10 10		GGGAGA #GAGAGA
-		IME.L.1510P) GO TO TO	. /	990599
		With 11 Table Co. Of Or Co. Contract 11 1001	11 3734	reman
		ONID: (OHIDIT.ATIME.MPAR.USFIS.IFILE.TAPELU.TAPEOL)		150000
•	* • •	(101).	LLHOJ ONG	nganan
and the second s	All hydronic fields of speciment of the field operations of the speciments of the contract of the speciments of the contract o	(L) TUO=(I,y) T		640000
*	•	(1) / 2/10 (2 1) / 2	K=0-1	850000
_		20 <u>7.58=0</u> 00		440000
)1(K · 1) = 0 11(n)	220 00160	91:0000
			K=0-4	540000
		₹8 • 08≡U_0;		##000 <u>0</u>
)T(K,1)=0UT(J)		640000
			K=7-3	240000
•		SZ.un=0 0		
		(L)TU0=(I,L)TI		040000
		9c+1=n 0		650000
•		046 01 00 (1.10.94)		<u>8£0400</u>
		hEBEOR (NEFC)	כעוד	780000
		KKF-OR		960000
	3	RADTHR (THETHE)		0.00022
		ELG.61.1) 60 10 540		θ
		SUCTON (IFLAGIUFLE)	CVFF	550000
•		FEC.01.1) 60 TO 540		0000035
		ELOW(JELG)		120000
	•	(I.UPUNI=(C) Lani 001	050000
	•	0.0=1:NbVB		000056
		SIBSN'I=I 0		820000
3		END*E0*0) CO 10 70	1) dI	750000
•		2E12*0E*20) @0 10 09	N) HI_99	<u></u> 680000_
			20 כעדר	950060
			01 09	0000Sit
	* * *		<u>גט כערר</u>	&S0000_
			CT 00	ganna.
		T(F10.0.F10.0.615)	T000 E0194V.	120000
and the second second	•	(5,1000) TSTART, TSTOP, INTI, INTR, IAVE, IFLAG, NRTHR, IEND	UN39 01	070000
		0=	:37131	610000 610000
			NSE13:	Z10000
		(AAM) NOUTUG		910000
			כעדה	510000
1		CHINE ((IVECIN: IVECOT)		910000
		(TASH) MUTAS		000013
		I:lbli0b		, S10000
/		\26.55.33\ AAM.AAUI.TAZI	1 4140	000013
	<u>}</u>	S10H 0UTFUT(120.50)	114 117 £ 14	000011
		Tqv1.Ivp1		00000
		1+ TAPEOT	11 3414.1	800000
)DEC	ESTID.DAY.PARID.CHANI.CHANZ.CHANZ.CHANG.CHANG.CHANID.UNITS	19 11 11	400000
		4 VCALCV TUPT(100) 6EOM(50) + 0UT(120)	40)414(0.0)	900000
		(50) TIME • IEND	TATINE	900000 900000
•	· •	I VIAPEZ TSTART. TSTOP. INTL. INTR. IAVE. NSETS, IMPUT(100.50)	10/4/102	h00000
		(100), CHAMID(200), UNITS(200), OEC(200), MPAR	TOTHAGE	200000
		1 VTAPETNY CHANI (100), CHAN2 (100), CHAN3 (100), CHAN4 (100),	IO-MMOD	\$00000
		\TIJFE\ TESTIO(12).OAY(2).RUNTME(2).IPAGE	- LOWWON	T 0 3 0 6 6
		(TROHZ=ATAU) A3.	TYMO2	. 100000
	•	$r_{ij} = r_{ij} + r$	/	
			0 1504021.1.1211 12	13 6
		6600	14 .2040ST.1.T2T.1 T	, D
			140,4282491	
	OS APR 72 PAGE 14	\$1100 •	. O 11 C B C 11 - C 4 T	

```
DATE 05 APR 72 PAGE
                   TAD: 428249:2:100 .
                        IF (IEND.EQ.1) GO TO 10
000057
                        STOP
090058
                        FND
โข้นนนี59
                        SUBROUTINE CHINPT(TAPEIN, TAPEOT)
000000
                        COMPTER (DATA=SHORT)
000061
                        COMMON /TAPEIN/ CHAN1(100) CHAN2(100) CHAN3(100) CHAN4(100)
~000062
                       1PARID(100).CHANID(200).UNITS(200).DEC(200).NPAR
000063
                        COMMON /TITLE/ TESTID(12), DAY(2), PUNTME(2), IPAGE
000064
                        INTEGER CHANI, CHANZ, CHAN3, CHAN4, PARID, CHANID, UMITS, DEC, END,
CUUUU55
                       1PARCK (100) . TAPEIN . TAPEOT
090056
                        DIMENSION DEF(100,10), ICHAN(4), IDN(4), DEFIN(10)
000067
                        DATA BLANK /
600068
                        DATA PARID / PATM 1, PSD 1, TD 1, PLF1 1, PLF0 1, PLRI 1,
0000059
                       1.PLRO ', WREE ', 'DPOPF1', 'DPORF2', 'PORF ', 'PTK ', 'TTK ', 2.PI ', '11 ', 'P2 ', 'T2 ', 'PTD ', 'P708 ', 'P726 '.
000070
"000071"
                       3'PDIFI1', 'PDIFI2', 'PDIFI3', 'PDIFI4', 'PDIFI5', 'PDIFI6', 'PDIFI7',
000072 .
                       4 PDIFI8 . PDIFI9 . PDIFO . N 1 P707 . P725 1/
000073
                        DATA ENDITEND I
000074
                         LIDE=0
000075
                         IPAGE=1
000076
                         READ (1) DAY, RUNTME, TESTID, TAPEIN, TAPEOT
000077
                         READ (1) MWORDS, (CHANID(I), I=1, MWORDS)
000078
                         READ (1) MWORDS, (UNITS(I), I=1, MWORDS)
000079
                         REAU(1) MWORDS, (DEC(1), I=1, MWORDS)
000000
                         TAPEIN=TAPEOT
160000
                         DO 100 I=1.2
280005
                         DAY(I)=BLANK
์ดิบดีบัย3
                     100 RUNTME(I)=BLANK
000084
                         CALL DATE (9.DAY)
090085
                         CALL TOD (8 RUNTME)
"000066"
                         IFLAG=0
000037
                         DO 210 I=1:NPAR
000038
                     210 PARCK(I)=0
0.00089
                         READ (5:20) TAPEOT
000090
                     240 READ (5,20) IDENT, (DEFIN(J), J=1,10), (ICHAN(I), I=1,4)
000691
                      20 FORMAT (A6,1X,10A6,1X,413)
000092
                         K=0
000093
                     250 K=K+1
000094
                         IF (IDENT.EG.END) GO TO 270
[000695]
                         IF (PARID(K).FQ.IDENT) GO TO 260
000096
                         IF (K.GE.HPAR) GO TO 255.
000097
000098
                         GO TO 250
                     255 WRITE (6,1000) IDENT
000099
                    1000 FORMAT (//10X:A6: IS AN UNRECOGNIZABLE PARAMETER IDENTIFICATION!)
000100
000101
                         GO TO 240
                     260 PARCK(K)=1
000102
                         CHARL (K)=ICHAR(1)
006103
                         CHANS(K)=ICHAN(2)
000104
                         CHAN3(K)=ICHAN(3)
006105
000106
                         CHANG(K)=ICHAN(4)
~000107
                         DO 265 I=2.4
000108
                         IF (ICHAM(I).FQ.0) GO TO 266
000109
                     265 M=I
"0uu110
                     266 DO 267 I=1.H
 000111
                         J=ICHAN(I)
000112
 000113
                     267 IDH(I)=CHAHID(J)
 000114
                         GO 268 I=1:10
 000115
                     268 DEF(K:I) #DEFIM(I)
```

en en grande. De la companya de la	(1904.85) & TITAL PROBLEM TO STAND TO STAND OF THE STAND	5/1006
	(ητ)Λ·(Στ)Λ·(τι)Λ·(στ)Λ·(σ)Λ·(σ)Λ·(σ)Λ·(σ)Λ·(σ)Λ·(σ)Λ·(σ)Λ·(σ	52.T000
*	7E(SS) X(E0*1***10*E1T****)*X	\$7.1000
	7 AAAA F (1) + (2) + (4) + (5) + (4) + (10)	271000
	DESIGN OUTPUT (120,50), NITME (50), NUM (10)	721000
	TEPETH*TAPEOT	0/1000
	IDIEGER HEGI DECTUMITESTIDIDATER (\$8) *6(88) *A(I#) *BLANK*	691000
	CORMON VIONENT HED(ISU) DEC(ISU) (IN(ISU)	891000
*	CORMON VIITLEN TESTID(LS).PDY(S).RUNTME(S).IPAGE	
	SUBROUTINE OUTPT (OUTPUT.ATINE.NPAR.NSFIS.IFILE.TAPEIN.TAPEOT)	
	EHI)	991000
	PETURA	891000
·	2010 FORMAT (12A6:12X:*DATE *.2A6**TIME *.2A6X)	401000
•	2000 FORMAI (*)**52X**LH2 PUMP TEST**##X**PAGE **I#)	\$31000
	(3A*X1*3A01*X1*3A*X1) TAMAOR OFOL	000162
	1000 FORMAT (A6+1X+10A6+1X+A6+5X+A1)	tatuou
	SOU CONTINUE	091000
	0-3NF-0	697000
	TF (LINE-LI-50) 60 TO 200	851000
	MB(LE (0.1010) HED(1) NED(1)	451000
	120 ΓΙΝΕ-ΓΙΝΕ+Ι	951000
, in the second of the second	WRITE (6.2010) TESTID-OAY-RUNME	
	70N47 (000740) 717W	951000
	1+29V41=70V41	COULES
•	IE (FIME:01:0) 00 10 120	_791000_
	READ (5,1000) HED (1), DEF, UN(1), DEC(1)	151000
•	10 S00 1=1, MBV3	051000
	SINVERE (I) IN OOL	6hI000.
	90 700 1=1.8AR	- 641000
	0=017	LHTOOD
		24,1000
		951000 951000
•	INTEGER HED.DEC.UM.BLAUK.TESTID.DAY.RUNTME	551000
	DIRENZION DEL (TO)	241000
	COMMON VIONENV HED(ISO), DEC(ISO), UN(ISO)	-
	COMMON VIILLEY TESTIN(12) DAY(2) FRUNTME (2) FIPAGE	241000
	Substance and the substance of the subst	141000
	LID	041000
	RETURN	000139
· · · · · · · · · · · · · · · · · · ·	IF (IFLAG-UE.0) STOP	85 I 0 0 0
· · · · · · · · · · · · · · · · · · ·	200_CONTINUE	
t	I=UVC=1	. 551000
į .	1020 FORMAL (AVIOX: 4 NO CHANNEL IDENTIFICATION FOR	821000
I^{-1}	WRITE (6.1020) PARID(I)	48,1000
	IE (PARCK(I), E0, 1) 60 T0 300	551000
1	270 DO 300 I=1.NPAR	. 581000
	90 TO 240	
	IPAUE=1PAGE+1	021000
	71115=0	000753
	IE (LINE,LI,50) GO 10 240	981000
	T+3MI7=3MI7	LSTOON
	TOTO EDIGNAT (1x, 66.2x, 10A6.4 (2x, 13, 1x, 66))	97,1000
• '	Seg WRITE (6,1010) PARID(K), (DEF(K,L), L=1,10), (ICHAN(I), IDN(I), I=1,N)	921000
	11SO FOREIT (IX:PARAMETER:20X:OFFIUTION:33X:CHANNI), TONII), 11SO	OORISE
	MRITE (6.1120)	000183
	WRITE (6,1130) TAPEIN, TAPEOT	221000
	1130 FORMAT (/* IMPUT TAPE = *.A6.5X.*OUTPUT TAPE = *.A6.5X.	000151
	(NAA = PGAT THOTHOLYDAYATANAT THORIT IN TAKAGA AFIL	0000150
	WRITE (6,1119) TESTID:DAY.RUNTE	67100
	1110 FORMAT (ISAFATSY TOATE **SAFATIME **SAFA	811000
	1100 FORMAT ('11.52X,'LH2 PUMP TEST', 44X,'PAGE '.I2)	711000 811000
		2 4 4 1/1/18
	WRITE (6,1100) IPAGE	

wanted by the control of the control

*1175.5

-

and the second second

	TAD,428249,2,100 .	DATE 05 APR 72 PAGE 17
	. 1	
000177	26H)/4X*** 6HSEC**3* 'X*** *(5X)	A6** *1/)*/
000178	DATA G(22) /*) */ DATA NUM/:1*, *2*, *3*, *4*, *5*, *6*, *	77001011109/
000179 000180	DATA BLANK /'	1,1,0,1,3,1,10,1
600181	/ IF (IFILE.GT.0) GO TO 100	•
000181	WRITE(2) DAY, RUNTME, TESTID, TAPEING	TAPFOT
030102	WRITE (2) MPAR, (HED(I), I=1, MPAR)	100.600
000184	WRITE (2) MPAR, (UN(I), I=1, MPAR)	
000185	WRITE (2) MPAR, (DEC(I), I=1, MPAR)	
000186	100 DO 200 K=1.MPAR.10	
000187	. IPAGE=IPAGE+1	
050138	L=K+9	
006189	11COL=10	
000190	IF (L.LE.MPAR) GO TO 150	
000191	L=:4f°AR	4
000192,	NCOL=MPAR-K+1	
000193	150 V(2)=NUM(NCOL)	
000194	V(7)=NUM(NCOL)	
000195	V(12) =NUM(NCOL)	
000193	WRITE (6.2000) IPAGE	
000197	WRITE (6,2010) TESTID:DAY:RUNTME WRITE (6,V) (1:1=K:L):(HED(1):1=K:	. () . () () () () () () ()
030198	M=1	76/F(UN(1)F1-K)E/
000199	DO 180 I=K.L	
000201	M=M+2	•
000505	180 F(M)=DEC(I)	
000203	DO 182 I=1.M	
000204	182 G(I)=F(I)	
000205	IF (M.EQ.21) 60 TO 200	
000,06	M1::411	
0.0005.04	00 185 ILMI+21	
000208	185 G(I)=ULAUK	
000209	200 WRITE (6.6) (ATIME(M). (OUTPUT(I.M)·I=K·L)·M=1·NSETS)
000210	DO 300 J=1.NSETS	
000211	300 WRITE (2) MPAR, ATIME(J), (OUTPUT(I	-J),I=1-MPAR)
000212	D0 400 (=1+30A)(
000213	DO 400 J=1.50	
000214	'400 OUTPUT(I,J)=0.0	
000215	IFILE=1	NY ABACE 4.70
000216	2000 FORMAT ('1',52X, LH2 PUMP TEST',4 2010 FORMAT (12A6,12X, DATE ',2A6, TIM	
000217	RETURN	
000218 000219	FND .	
000219	SUBROUTINE GEOMT	
000225	COMMON /CALC/ INPT(100),GEOM(50),	OUT (120)
000221	COMMON /TITLE/ TESTID(12),DAY(2),	RUNTME(2), IPAGE
000223	REAL INPT	
000224	DATA NUM/30/	
000225	EQUIVALENCE (SEOM(1).DSL1).(GEOM	
000226		(5),ALRR),(GEOM(6),CLABR),
000227), DT2), (SEOM(9), BET2).
000228	3 (GEOM(10) • Z2) • (GEOM(1	1), PPTAP), (GEOM(12), ADFD),
000229		14),RHORFF),(GEOM(15),OPFD),
000230		ON(17),ORFBTA),(GEOM(18),W),
words H		(20), 2707), (0104(21), 8708),
060232	7 (CEOM(22),R724),(GEOM	(23),R725),(CTOM(24),R726),
600233		26) - RLM) - (GEOM(27) - RLI) -
000234	9 (GEOM(25) RIN) * (GEOM(

	TAD:428249:2:100 .	DATE 05 APR 72 PAGE 18
000237	1010 FORMAT('1',52X,'LH2 PL	MP_TEST*,44X,*PAGE *,14)
000237	WRITE (6.1020) TESTIO	
000236	1020 FORMAT (12A6, 12X, DATE	
000239	/ PEAD (5,1000) (GEOM(I)	
	1000 FORMAT(8510.0)	
000241 000242	WRITE(6,2000) DSL1	
000242		CTION LINE DIAMETER UPSTREAM FLOW COND.**30X
000244	1.F6.3.' IN')	
000245	WRITE(6:2010) DSL2	
trauling	2010 FORMAT (* 1/5/L? SI	ICTION LINE DIAMETER DOWNSTREAM FLOW COND.**
0.00247	128X,F6.3,* IN*)	
ย้อยสัส	WRITE (6,2020) ALBF	
to a real	SOSTI FOR ALL CT ALLS	FORT LABYRINTH FLOW AMEA**46X*F6.3** SO-IN!)
636250	14 L (6.2630) CLABE	
000251	2030 FORMAT (* CLARF FF	TONT LABYRINTH COFFFICIENT • . 444× • F6 • 4)
000252,	WRITE(6,2040) ALBR	i
000253	2040 FORMAT (* ALBR RE	FAR LABYRINTH FLOW AREA: 47X+F6.3+! SQ-IN!)
000254	WRITE (6,2050) CLARR	
000255		FAR LABYRINTH COEFFICIENT*,45X,F6.4)
000256	WRITE (6,2060) AT2	
000257		APELLER DISCHARGE BLOCKED AREA*,40X,F6.2
000258	1* S0-IN*)	•
000259	WRITE (6.2070) D12	
000260	2070 FORMAT (DIZ IN	PELLER DISCHARGE DIAMETER: 444X+F6+3: IN:)
000251	WRITE (6,2080) BET2	
000262	2080 FORMAT (BET2 I	PELLER DISCHARGE BLADE ANGLE',41X,F6.2,
030263	1' DEG')	,
000264	WRITE (6,2080) Z2	
of the second second		MORR OF IMPELLER PLACES'(50X)IS)
10002 16	UPATE (0,3000) RPTAP	
0000557		
000268	3000 FORMAT (RPTAP D)	IFFUSER INLET PRESSURE TAP RADIAL LOCATION:
The second	2. 12.15 70.21 1 1	
000270	. (9/145 (6:3019) ANED	
000271	3010 FORMAT(* ADFD -D)	IFFUSER DISCHARGE FLOW AREA*,42X,F6,2,
000272	1'S0-IN')	
000273	WRITE (6,3020) DDL	
000274		ISCHARGE LINE DIAMETER*,48X,F6.3,* IN*)
000275	WRITE (6,3030) RHOREF	
000276		EFERENCE DENSITY',54%,F6.4,' LB/CU-FT')
000277	WRITE (6,3040) ORFD	EARTHE COOLANT ADJETCE DIAMETER: 394.F6.4. 1 c.
00u278		EARING COOLANT ORIFICE DIAMETER 1,39X1F6.41
000279	1' IN')	
000280	WRITE (6,3050) ORFCOE	EARTHG COOLANT ORTFICE COEFFICIENT . 36X.
000281		CARTING COORDING ONTHICE COSCIPICIENT FOON
282000	1F6.4)	
000283	WRITE (6:3060) ORFBTA	FARING COOLANT ORIFICE BETA , 43X, F6.4)
-00u284		PARTING COOLART OF PRESSURE TAP 7071,35%, :
1002 D	2670 FOR A **707	The state of the s
000.:36	PRINE (6:3070) 1:707	
000757	TORREST (*)	DIFFUSER VANE INLET WIDTH: 45X+F6.4+! IN!)
0บ02ชช		DIFFURE AND THE LETHINSARY DEAL TOOL
New State	() () () () () () () ()	GARYAT "LOCATION OF BUSINESTAD TOCK, 35V.
7000290	= - · · · · · · · · · · · · · · · · · ·	RADIAL LOCATION OF PRESSURE TAP 7061.35X.
000291	1F6.4, IN!)	
000292	WRITE (6,3090) R706	DATE OF TAXABLE PROPERTY DESCRIPTION OF TAXABLE PROPERTY DESCR
100u293		PADIAL LOCATION OF PRESSURE TAP 708 735X
	4000 FORMAT (* 18708 166.47* IN*) VRITE (674000) 18708	NABIAL COCATION OF PRESSURE TAP 108, 1997

·	TANGGREGORIES - BATE 95 APR 72 PAGE 19	
	141 moves (- 210)	
333227 533233	/ Artific to mitter 2720	
33 13 13 13	AUCTIVITIES OF 17:17 CADIAL LOCATION OF PRESSURE TAP 7251.35%	
111300	The second of th	
100301	/ PRINT (6:4030) R725	
774391	4030 COLLEGE 1236 CADIAL LOCATION OF COMMODINE TAP 726**35**	
1,1 1 jel.j	attornet title	
1 1 1.34'6	110 (5) (5) (5) 8725 4094 (5) (6) (7) (6) LAGYRIBER LAND RADIUS! (49X) FO. (4) (10!)	*******
و د د از د د		•
ول ۋاۋال ل مارورو	ACA AC (G 25 17 0) REF	
4 2, 4 3, 4 3	11. (6.11) RL1	
(1,1,1,1)	4000 FORTHY C. C. L. LABYRITTH LAND RADIUS: BOX+F6.4. P. INT.	
1.134.0	F1. (7: (3:21) 1) 10. T	
	4073 CONTAC (CONT.) FIDUCER RAD/US*+56X+C6+4+ + TO*) 4	
و شدنانان	(14761 (074070) RIS	
440313	4000 POLINE (* 1801 - LAMPETITE LAME PARTIES 49X, FR. 4. 111)	
Trains	4090 (5.2000 BL) SHAFT RANGOS+58X+F6+4+* INF)	
And the State of t	4990 (500 (4) C. 3. SHAFT RAPLUST 1988 (10) 44 (1) 11 () () () () () () () ()	
1111111111	A. J.W	
1993947 1993954		
31741	STANDUTTER SUCTOAL (IPLACAPEG)	
93.613	Commence of the same of the sa	2.
C.1.6323	Contract to the contract of th	
Q 401 541 1	C APPENDIT AND CONTRACTOR OF TRANSPORTED CON	
فندووو	C NEPTHER TOOL FOLD HET FOR THE FOUNDE OF PROME OF FLOW CONDITIONER C NEW HOLD MERCHOND MORNING DOWNSTOTAN OF PLOW CONDITIONER	
and the	A COMPRODUCTAL DV CONTROL OF MICHAEL CONTRACTORS CONTR	
1 1 1 1 2 1 1 3 1 1 2 3 1 1	TTC 一直打造,是自己的人类的主,还有的相对了自己的特殊的人类的,是是以其中的特殊的特殊的人类的。	
30 1 1 3 1 1 3 2 1 1 3 2 1	- C - (1) (C + (1) (1) / (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	
3000000	C PRODUCTION OF THE PROPERTY DOUBLES AND OF FLUID CONDITIONER——BIOZER	
	C HEAVE METERS OF THE CORRESPONDING TO SEE-FITBALLY CONTRACTOR OF THE CONTRACTOR OF	
<u> ም</u> ስዕ <mark>33</mark> ባ	C STRUCTUREDY IN TAUCHSTUZES	
A Dankey Comment	C OPSCIANCE POSTTOE SUCTION MEAN USING MPSP AND RHOSATFT	
of the little	C ::::::::::::::::::::::::::::::::::::	
2.25333	C REPUBLICATION OF BUTTON CONDITIONER——PSI C REPUBLICATION OF FLOW CONDITIONER——PSIA	
13331	C P320 (1790) 1 (1990) 00 (109 C010 1100) (1990)	
000335	C PRIESCHART DE PORSSORT DO MISTREAS OF FLOW CONDITIONERPSIA	
3.3.7	C = O(C) = C = O(C) +	
1.3511	C PYA 14 DEPART CONSIDER OF FROM OF FROM COMPUTABLES AND STATES OF THE OWNER COMPUTATION OF THE	
1.2.4.5	- C - 247,259 (200, 12 PD SECTOR CO PROPORTORIO TO 52 0 - 1 85 A - 1 1 1 1 1 1 1 1 1 1	
UUUJ+U	C PVAPTK=VAPOR PRESSURE IN TANKPSIA	
000341	C RHO1=FLUID DENSITY UPSTREAM OF FLOW CONDITIONERLB/CU-FT C RHO2=FLUID DENSITY DOWNSTREAM OF FLOW CONDITIONERLB/CU-FT	
000342 +	C RHOLID=LIQUID DENSITY DOWNSTREAM OF FLOW CONFITIONERLB/CU-IN	
000344	TO REGISTESATIDATION DENSITY CORRESPONDING TO SET-LUZUOTET	
000345	C RHOVAPEVAPOR DEMSITY DOWNSTREAM OF FLOW COMPITIONERLB/CU-IN	
000346	C S2=ENTROPY DOWNSTREAM OF FLUID CONDITIONERBTU/LB-DEG R	
000347	C 11=TEMPERATURE UPSIREAM OF FLOW COMPITIONERDEG R	
000348	C T2=MEASURED TEMPERATURE DOWNSTREAM OF FLOW CONDITIONER DEG P	
000349	C T2CALC=VAPOR TEMPERATURE CORRESPONDING TO S2DEG R	
000350	C TIKETANK TEMPERATURE———DEG R C VIEWERAGE FLUID VELOCITY UPSIREAM OF FLUID COUDITIONER———FT/SEC	
000351	C VIEWARDOR FURTO VELOCITY TORGET OF FULLY CONTINUED FT/SFC	

	TAD:428249:2:100 .	DATE 05 APR 72 PAGE 20
000357	COMMON /SAT/ HSAT(25) +PSAT(25) +TSAT(25) +SS	AT(25) +RHOSAT(25) +
000358	/ 1EMPT (25) + EMPS (25) + EMTS (25) + EMHS (25) + EMRHOS	.(25)
, , 1	///	
500754	/ 27% MPT	
Literal.	/ : 1 - 4 N. 1 D. 1 COMPT (12) - OCO - COMPT (13) - TOO -	(TMPT(In),PL),
2 8 10 4 2 2	(CHPR (T22) + (THPR (T22) + (T	
i), ; ; ; ;	TEL AMELIET CHILLETTOLD (GALLET) *021 * (C	#IT (13) + PM (OTK) +
	((ant (1-)) (1/1) ((ant (1/1)) (8401))	OUT(LS),V(),
	2 (90) (17) (10) (00° (13) (11°) (0	(1,(10)*\text{\tiny{\tity{\tiny}\tiny{\tiny{\tiny{\tiny{\tiny{\tiny{\tiny{\tiny{\tiny{\tin
or this is a second	5 (OHT(Q)), THOO;), (OHT(Q1), VQ), (O	## (22) ##!) •
	4 (0011(03)+401) (0011(00)+94/90) .	(001(25))(52))
5 7 10 8 6 2	5 (00f(25), 23), (00f(33), P2f), (0	
لايادادا	OUT (2.3) * (PGHA) * (OUT (30) * (PGH	(001 (31) (3)) (3) (3) (3) (3) (3) (3) (3) (3) (
000010	7 (9817 (32), 38, 94A), (99T (33), T293	7.1 (00) (24) (KINCTO) (
4.6471	8 (2011 (35) FOR (2) FOR (36) FOR (36)	4
	7912447 DT (6000(2)+05L1)+(6000(2)+05L2)	!
	4140.14459883.1662/6.	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	· · · · · · · · · · · · · · · · · · ·	
0003/5	N=22 C*** COMPUTE TANK COMPITIONS	
000376 000377	CALL PIENTH(PTK.TTK.1.HTK.JFLG)	
000378	IF (JFLG.6T.1) RETURN	
000378	CALL SPLIT (N.TSAT, PSAT, EMPT, TTK, PVAPTK)	
ີປປ ບ ວຣ0	C*** CHECK FOR VAPOR UPSTREAM OF FLOW CONDITIONS	R
000331	IF (P1.GT.PVAPTK) GO TO 90	
000332	WRITE (6,1020)	
000383	1020 FORMAT (POSSIBLE VAPOR UPSTREAM OF FLOW	CONDITIONER')
000384	90 CALL PIDENS(P1.T1.1.RHO1.JFLG)	
006385	IF (JFLG.GT.1) RETURM	
ัดอยู่อักก	V1=144.*.(901/(RHO1+A1)	
$0000^{2} \odot 7$	4 () 28 () (A () 1 • () • () • () () () ()	
4	the state of the s	
しいいしいジ	11-11/2000/(1-02-170-770-16)	
006390	CALL SPLIT (H. TSAT, PSAT, EMPT, TI, PVAP1)	
000391	IF (P2.LE.(PVAP1+3.)) 60 TO 100	
00. 2	C ** CUBLE PHASE DOUBSTREAM OF FLOY CONDITIONS	_R
00a. 3	CALL PROSING(PRITERS, RHORINGLE)	
000354	IF (JFLG.GT.1) RETURN	
000250	CALL PTECTH(PATRASHPAJELS)	
500539 000397	TE (.0°L5.01.1) + CTOκθ V2=144.ε.,001/(Rh02*Λ2)	•
00039 7 000398	H2T=H2+V2**2/(2.*32.174*778.16)	1 47
000399	CALL PTENTR (P2.T2.1.S2.JFLG)	
000399	IF (JFLG.GT.1) RETURN	
000401	RHOLIU=RHO2	
000402	x2=0.0	
050403	B=0.	• .
006404	ALPHA=0.	
000405	RHOVAP=0.	
U06406	GO TO 160	
000407	C*** POSSIBLE TWO PHASE DOWNSTREAM OF FLOW COND	ITIONER .
000408	100 H2=H1	
000409 .	IF (IFLAG.NE.O) GO TO 105	
000410	HIOT=HIT	
000411	GO TO 106	
030612	105 HTOTESTK	
000413	106 ICOUNT=0	

	TAD:428249:2:100 ,	DATE 05 APR 72 PAGE 21	
600017	CALL PHDENS(P2+H2+1+PH02+RH0LIQ+X2+JFLG)		
000417	IF (UFLG.GT.1) RETURN		
0.00418	IF (RHOLIQ.61.0.0) 60 TO 120		
000419			
050420	/ PHOLIGERHO2		
000421	/120 V?=144.*WDOT/(RHO2*A2)		
0.19422	H26Es=HT0T-V2**2/(2.*32.174*778.16)		
Carlot of V	ነዶ (ለምና(1.⊸Ho/NE/mp).(ሞ.ሰ.Ghanj) ዓለ ፓን 15ባ		
4 (1 2) (
0.000	H (10 d) 20 10 119		
C)6426	WRITE (0.1000)		
000427	1000 FORMAT (SOLUTION FOR ENTHALPY DOWNSTREAM OF	FLOW CONDITIONER 1910	
09.5.38	1 HOT CONVERGE IN 20 ITERATIONS!)		
636.69	150 CALL PHENTR(P2.H2.1.52.JFLG)		
000430	IF (JFL6.Gf.1) RETURM		
1 391.33	H21=P2+2(11.07(2.+32.170+778.16)	4	
Constraint	PHOTER=Y24-molifo/(PHOLIO/RHOS+X2-1.0)	· · · · · · · · · · · · · · · · · · ·	
006433	B=X2*RHOL16/((1X2)*RHOVAP)		
	ALPHA=B/(8+1.)		
030434	C *** FIND SATURATION PRESSURE CORRESPONDING TO S2		
000435	160 CALL SPENT (N.SSAT, TSAT, EMTS, S2, T2CALC)		
. 6 10436 :	CALL SPLIT (N.SSAT, PSAT, EMPS, S2, PVAP2)		
0.104.37		•	
0.10438	CALL SPLAT (N.SSAT. HSAT. EMHS. 52. HLIO2)		
000439	CALL SPLUT (N.SSAT.RHCSAT.EMRHOS.52.PHOL2)		
04400	0S=448.86*bU0T/RH02		
QJ0441	300 P2T=P2+RHO2+V2+*2/(2.*32.174*144.)		
636442	PTES1=P2T+0.5		
600443	CALL PHENTR (PTEST , N2T , 2, 511 , JFLG)	·	
040444	IF (JFLG.GT.1) RETURN	•	
(1-11) ⁴) ⁴ (4)	pp=prfSf-P2T	The Control of the Co	
domest.	TOO (1) I al		
received to a	Strain with their entry than a that a nation to the Hotel		
	IF (JELG.61.1) RUIURN		
Programme Commence	DS=S11-STEST		
069443	DBDS=DB/DS		
000450	IF (ABS(1STEST/S2)-1.0E-05) 350.350.320	·	
000451 .			
000452	320 IF (ICOUNT-30) 330,340,340		
000453	330 ICOUMT=ICOUNT+1		
000454	511=STEST		
000455	DP=UPDS*(STEST=S2)		
000456	PZT=PZT=DP		
9035 1 7	71. 31.5	1 2 ,	
	\$66 (12) (() 1 (())		
000459	1030 FULLET (* 16 SOLUTION FOR 2271) .		
000460	350 PPSP=P2T-PVAP2		
000461	MPSHA=144.*NPSP/PHOL2		
000-52	450 PPSHB=778.16*(H2T-HLI02)		
000063	500 RETURN		
0.1000	END		
นบบ4ว5	SUPPORTY OF FLOW (JELG)		
000455 009466	CONTROL / CMTC/ INSI(100) * GEOM(20) * ONT(150)		
A LANCE CO.	REAL INPT		
000467	EQUIVALENCE (GEOM(3) + ALBF) + (GEOM(4) + CLABF) + (GE	OM(5) ALBR)	
000468	1 (GEOM(6), CLARR), (GEOM(13), DDL), (G	EOM(14),RHOREF),	
000469		(GEOM(17),ORFBTA)	
000470	EQUIVALENCE (IMPT(2), PSD), (IMPT(3), TD), (IMPT(4),PLFT),	
000471	1 (THET (5), PLFO) + (IMPT (6) + PLFT) + (IMPT (6)	PT(7) •P(RO) •	
000072	$\frac{1}{(1,0.1,0.1)^{4}} \frac{(1,0.1,0.1)^{4}}{(1,0.1,0.1)^{4}} (1,0$	THET(10).DPORE2).	
690473	5 (T.B.) (8) * MREE > * C. Die (C.) * Die (C	AND THANK FOR SOME EAST	.**
000474	3 (UNPT(11), PORF)		

			- 074 	5675490 626490
		7 = 16450±±5 7 = 15450±±5		ες gnou
and the second s	والمقافلة ومعاهدة والمدار ووالمعافدة والمداروة الولودة الميزور ويوا) = 8589445		703335
		5 = 07064+2		TEMOON .
	4.) = 0707**2 ·		083000
	The second section of the second seco	0 = 8108**2		685000
		DS/20		. 000288
•			THAT ZNO 3-3	
		:INPT(1)/2,036		923000
			O PYFIII	929000
		(OUT(101) FROV) (OUT(102) FAX) (OUT(20) RHO2)	6	#38000
		(001(94),FP),(001(99),F723),(001(100),FAS),		626000
	•	(OUT(95), PLD), (OUT(96), XKDOU), (OUT(97), XKDOV),	1	00005S
•	4.	(OUT(92), FFOV), (OUT(93), EMT), (OUT(94), P2R),	ξ.	125000
		(00)1(89),FE),(001(90),FELB),(00T(91),FIH),		000250
	•	(OUT (86) PP.F) (OUT (87) XKSOU) (OUT (88) XKSOV)	704.3	615000
		AALENCE (OUT(11), VWIN), (OUT(34), RHOSL), (OUT(85), P2F),	EOUIT	
	• 😛	(NP.(16)74HI)		
,		(711917), (7279, (7279, (7279, (7)1917)	<u> </u>	712000
	$\Delta = - \frac{1}{2} \left(1$	(typr(4), P706), (14Pr(5), P705), (14Pr(6), P724),	T	01/10/0
	<u> </u>	VEHCE (1051(19) bS) (1461(10) b200) (1461(S0) b229)	/1003	SIG000
		(ST8*(20)*6E3)	ti .	1,75000
·		(CEO//(S1) * &FI) * (@EOW(S8) * &I/A) * (@EOW(S8) * &FD) *	ξ	\$13000
		(PEO)/(St) + UASP) + (PEON(SP) + GFE) + (PEON(SP) + HFW) +		
		(CEOW(SI) *BA08) * (PEOW(SS) *BASE) * (PEOW(SQ) *BASE) *	τ	115000
	•	ALENCE (GEOM(8) DS) (GEOM(19) R706) (GEOM(20) R707)	\Ino?	0.000
	•	1401		
		W \CVFC\ IMBI(100)'0EOW(20)'ONI(150)		ยกรอด ด
		NATINE AXEOR	DHAUS	L(68)006
•			Gh3	565900
		W. W	bELINI:	904000
		WEBRY#S	=81C T 31	#68960
		• \$6X401PP	= 40'48'	
		स्वातिकारी हैं।	171=S/4	ភាគមានគ ា
		ON ELOW	lions o	105300
,		HO HOORING ELOM		
		O+PPBH14CTVBG+ALBB*SART(RHORL*OPLER)	=\(\text{θ} \) \(\text{\text{\$\sigma}}\)	664600
		FLG.61.1) RETURM	IE (T	85±000
		PHDERS (PLROPHSDR, #, RHORL, RHOLR, OUAL, JELG)		Z65000
		- 1817 - 1817 (C)	(inda)	964900
		Representation of the second o		GAMAAA
1		(ธยาสมั≉าสัยคุยั)1เพื่5∗สัลาฟ+ฮ. 13 / 15√9 ำเ		Sp. 1916(III
		# CC 6/12 CD	d Tald	£64969
		FLG.61.1) RETURN		7864000
,	.	EFO TO THE PREZIDENS REPORT NUMBER NOT NUMBERS (FLEOFING)		164000
	Y	La 131.4 IAITH FL. 000		065900
•		TUDARISH ELOM		694000
•				885000
		• 2525 + 0/4 COE + 0/4 EVI V ** \$ * 3/4 EVI (3/4 OB 3/4 EVI) * 2525 + 0/4 COE + 0/4 EVI V ** \$ * 3/4 EVI (3/4 OB 3/4 EVI) * 3/4	0-0100	Z89000
	•	•2SPS*OBECOE*OREGIV**S*OBED**S*2001(BHOBBE*DBOKET) EFC•cl•1) Belabu	0-100	955000
				595000
		SHDERS (SORE FREDRING VEROBRE FRE FOR THE FOR	- 1142	464000
	•	FLG.6T.1) RETURN		£1-4000
		PTCN114(PSD.TO.44/USDB.JFLG)		254960 \$54900
		8*86*VD/RHOD		***************************************
		EE*ISHOONEHOBEE		785600 004000
. •	•	FLG.6T.1) RETURN		0.000
		PTDENS(PSD,TP,3,RHOD,JFLG)		67 F000
		(OUT(11),WS),(OUT(103),WRRG)	Σ /	874000
		(A018 (01) TUO) (A81W (9) TUO) (J90H9 (A) TUO)	S	774000
			1V198744	

•

.

in the state of th	The second live of the second	1:/*(1/9; = /1 3) (G	Contract (
A CAMPAGE OF THE PARTY OF THE P		(7989, (88) 100) t	40.5000
		1001 4 8 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Circl (11)
٠		FOULVALENCE (OUT(AU) FUSE) . (OUT(A1) ARETA) . (OUT(82) - REP) .	20,5000
		EUNIAVERICE (GEOW(R)*DIS)*(GEOW(IB)*M)	169000
		FGUIVALENCE (THPT(21),P(1))	•
		DIAFRION 5(0)*THETA(10)*EX(9)*FY(9)	069000
		COMMON \CALC/ INPT(100),6FOM(50),0UT(120)	685000
•		SUBROUTINE RADIHR(N)	RRSOCO
		EMD	7 83000
		метови	985000
			585600
	•	TMH-VOHH-VOHH=XAH	#8306b
		C-AXIAL THRUST POSITIVE TOWARDS SUCTION	
		FROV = FR + F723 + FAS	686000
		C-BACKSIDE PRESSURE FORCE	866900
•		EVS = 3*10114 BITS**S* DVWB	
		C2/J+(NCDN+N(NCDN+) 1 + 1 + 2 + 2 + 2 + 3 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4	093000
	• •	2874 + 25874 = 87	672000
			873360
	٠ ي	ERRE = 1.5708*(R7250 - RLDO)*(P725+PLD)	778060
		ERZ5 = 1.55708* (025 - 07255) *(P284: 725)	7.7.200.00
•		C=D12K Bith 3200c EOnGE?	923000
<u>, </u>	•	XKDOV = XKK * SORT((P726-P724)/(R7260-R7240))	
3	· · · · · · · · · · · · · · · · · · ·	XKDOU = XKK * SORT((P726-P725)/(R726-P7250))	6Z9000
		C-K-AVERES DISK	£29000
	• .		รั้นรากกั
		PLU = P725 - (R72540-RLD0)*(P725-P724)/(R7259-R7240)	172000
		P2R = (R20-R7250)*(P726-P725)/(R7260-R726)+P725	
		Capressine extrapolations disk	67.2990
	1	· · · Bla + Blaa + aa = VCaa	604000
		C-EKOMI 210E BKL226BE EOKCE	86.1989
* * * * * * * * * * * * * * * * * * *		FMI = 0*IND * AMIN*SVISHOOF	19600
		с-моизгилм ноиск	gerjang.
			G OGGGG
and the same of a special property of the same and the same of the		E111 = 3.1117 * RIMO * PS	#95000
	•	C-PRESSURE FORCE INDUCER	
		EFUB = FLB + FLB + F705	<u></u>
and the state of t		F705 = 3.14174 (RLIQ - RINO)*P705	Sadobas
	•	EFT = 2*1413*(BFWG = 1510)	196,600
		MAUG* (0MUG - 031) +71417 (NE = MAUG) *PLMO)	0.04900
		C-PRESSURE FROMT LAPPRIME	699000
to the state of th		HINTOAGU I MANAGANA ANAGA G	855000
	• •	- PLF → PLF → P705)/3.	Z59000
		PLFI = P705 + (PLF - P705)/3.	
		C-LABYRIMH PRESSURES	9955989
1 · · · · · · · · · · · · · · · · · · ·		EE = EESA + EEAF	623989
		FF7L = 1.5708+(R7070-BLF0)*(P707+PLF)	454000
		FF Z Z = 1,5708, (R20-P707) * (P2F+P707)	643346
		C=SHROUD PRESSURE FORCES	ຳ ຊື່ອີອີອີອີ
	4	C-Charle barecine roads	199109
	· ·	XK20V = XKK + SURT((P708-P706)/(R7080-R7069))	
		XK200 = XKK * 2081((6106-6101)\(61080-61010)	054101
•		XKK = IIOSS*\ZM\ZOKI(BHOS)	. ५५५५८३
•		C-K-AVENES SHKOND	មកភាពជ
		PLE = P706-(P7060-RLEG)*(P707-P706)/(P707-P706)	2 MG000
	•	P2F = (R20-R7070)*(P708-P707)\(R7080-R7070)+0707	965060
		TOTAL CONTRACTOR CONTRACTOR AND THE CONTRACTOR AND	gasson
		C-PRESSURE EXTRAPORATIONS STROUD	455363
		DF20=BF2++5	95 50 65 91 50 65
		PLDG = RLD++2	
		<u> </u>	
		87250 = 8725.**2	1 47060
		. P7260 = 87264*Z	04/9000
	•	PINO = BIN**2	685060
			690638
		RL10 = RL1**2	
		Z**♥□4 = 0P□4	<u> የይ</u> ፈፀፀ9

:

.

```
DATE 05 APP 72 PAGE
                   TAD,428249,2,100
                       DO 10 I=2+N
000597
                     10 THETA(I)=THETA(I-1)+DTHETA
000598
                        THE TA(N+1)=THE TA(1)+360.
[000599]
                        SUMEX=0.0
000600
                        SUMEY=0.0
000:01
                        DO 110 I=1.N
0006.02
                        PHI = (THETA(I+1)-THETA(I)) / 2.+ THETA(I)
000603
                        IF (PHI.LT.0.0) GO TO 40
000594
                        IF (PHI.LE.90.0) GO TO 50
800605
                        IF (PHI.LE.180.0) GO TO 60
000696
                        IF (PHI.LE.270.0) GC TO 70
900637
                        IF (PHI.LE.360.0) GO TO 80
មិលមិល
                     40 WRITE (5:1000)
000009
                   1000 FORMAT ( ANGLE LESS THAN O OR GREATER THAN 360 DEG, RADIAL THRUST
000/10
                       ICALCULATION TERMINATED!)
000631
                        RETURN
0.00512
                     50 PSI=PHI
0006.13
                        SIGNY=-1.
000.014
                        SIGNX=-1.
0000115
                        60 TO 100
000 15
                     60 PSI=180.-PHI
0004.17
                        SIGNY=-1.
000718
                        SIGHX=1.
000019
                        60 10 100
du 520
                     70 PSI=PHI-180.0
000621
                        SIGHY=1.
Ottoda
                        SIGHX=1.0
60t+25
                        GO TO 100
00% 39
                     80 PSI=360.-PHI
0000025
                        SIGNY=1.
Obertalo
                         5160%=-1.
000027
                    100 F=P(I)+W+DI2*ABS(SIN((THETA(J+1)-THETA(J))/(2.*57.296)))
0006888
                        FX(1)=F*SIUHX*COS(PSI757.296)
Cook29
                        FY(I)=F*SIGNY*SIN(PSI/57.296)
000630
                         SUMEX=SUMEX+FX(I)
950031
                    110 SUMFY=SUMFYSFY(I)
006632
                         IF (SUMEX.LE.0.0) GO TO 150
0004.33
                         IF (SUMEY.LE.D.D) GO TO 130
000034
                        BETA=57.296*ATAH(SUMFY/SUMFX)
J00635
                         GO TO 200
000636
                     130 BETA=57.296*ATAN(SUMFY/SUMFX)+360.
006637
                         GO TO 200
[001.538]
                     150 BETA=57.296*ATAN(SUMFY/SUMFX)+180.0
 100639
                     200 PUSL=SORT(SUFFX**2+SUMFY**2)
 0.00640
                         SUMP=0.0
000541
                         DO 300 I=1.N
 Juou42
                     300 SUMP=SUMP+P(I)
 000043
                         PAVE=SUMP/N
0005544
                         PEP=RUSL/PAVE
 000645
                         RETURN
 0000545
                         CM3
 000047
                         SUBROUTINE PERFOR(JFLG)
 000048
                         COMMON /CALC/ INPT(100), GEOM(50), OUT(120)
 005649
                         REAL IDPTIN
 0000000
                         EQUIVALENCE (GEOM(9).BET2).(GEOM(10).Z2).(GFOM(13).DDL).
 U004.51
                                      (GEOM(8),DT2),(GEOM(7),AT2),(GEOM(11),RPTAP),
 U00652
                                      (GEOM (12) PADED)
 0000053
                         EQUIVALENCE (IMPT(2), PSD), (IMPT(3), TD), (TMPT(1A), PID),
 000054
                                      (IMPI(19),PIIP),(IMPI(20),PRITP),(IMPI(21),PRIFII),
 ddouvv
                                      ATTHORY SON COMERCIAN ACTION TO COME AND THE TABLE OF COME SON THE TABLE
```

1917-1WEL2X776.16 *015547424(PS1TH**24PH12**2)	HBTJDEHJ HAEDSEO		917 mma 917 mma
PH12/TNF?-SP	•I=HLISd		277700
ION (RHOID*AIZ*U2)	##1=SIH9 00#		0.00411 ·
.s\(9179+917 000			017700
24AF8E	SM=dWISM		607000
<pre># EFOM COELEICIEM1</pre>	IW5EFFE8 . ONZ≐ORVN	. J	807000 ·
IZIINII**S			964,000
######################################			90Z000
	Io=115d0	3	<u>+6</u>
₽₽RE08MANCE •1D≉/307MS			207000
8ATHUXII			167900
. (ASTH-802)			007000
H2TH-0GTH	PNG0=GH0 H1=8ATHG		66990 0 869960
50+32-174/112**2			793969
	HNSO=DHI		ganna .
\$1.877*(821H-9021)	H)=0SIHQ		
. (1.13) RETURM		*	ნტეტეტი წ გვეტე
JIH(BID:SS:T:HISOB:JEEG)	258 7742 . 018=0180		\$6400g'''
			169969
91*844/TEAGR#80			062060
• htt/TIMDA#GoHa-			669900.
15**2\2*\170			विकास हो। राज्यकार्य
96**NV/2**********************************			1337-5144-41
1113 (15.01) 1.0) 1.0 (15.01)			egranica.
29-015-41/7280			h2000)
BALL PERFORMANCE			669000
120\n**DDF**S 120*2TH(DELTSB)\XS			ដូន១១៤១ ស្រាកខាង
	NVI=230I		aemana .
15/21.596	BET2R=9E		623960
-	TMATZMOD	3	829960
(OD1(24)*HO2F) NCE (OD1(52)*HZB)*(OD1(53)*HZB)*(OD1(53)*B1Z)*	ב מסז אייבבי		ZZ1060
NCE (OUT(82) PDIEIN)	EGUIVALE		97.500
(OA) • CHC(OV)	GG		PY a 5 0 0
(OUT(72), CHITD), (OUT(73), HCTD), (OUT(74), DHCDE),	tı		87.0000 000072
(001(99)*DHCH9)*(001(94)*DH12D)*(001(98)*EELWB)* (001(99)*DH111)*(001(44)*DH12D)*(001(98)*EELWB)*	S. S.		170900
(OUT(64), PM2IS), (OUT(64), PMCIS), (OUT(68), HCIT), (OUT(68), EELMP), (ANTIO)	ī		07.50.00
(0a) (0a) (0a) (1a) (1a) (1a) (1a) (1a) (1a) (1a) (1	6		699968
(001(E7),PH12),(001(5P),PS11H),(09)(B1MP),	9		ემიიი <u>ა</u>
(OUT(5E),EETD),(OUT(5S),EETDO),(OUT(5S),DPSIN), (OUT(5E),DHSIN),(OUT(5S),HSINS),(OUT(5E),ONS),	<u>د</u> 9		293666
(0.11HG,(0.11HG,(0.11HG,(0.11HG,(0.11HG,(0.11HG,(0.11HG),(0.1HG,(0.11HG),(0.1H	ś		
(STIIG*(Sh)100) (OAL(#6) +iniso) (OAL(#1) +iniso) (OAL(#1) +iniso) (OAL(#1) +iniso) (OAL(#1) +iniso)	12		409000
(OLD (42) *HIOO) * (OLD (42) *DOAD (40) *(OLD (44) *DOAD (42) *	2 2	· •	\$9966 0 \$9966 0
(OUT(6), WLRF), (OUT(40), WLRF), (OUT(11), WS), (OUT(12), OS), (OUT(85), 4SS), (OUT(40), VOIS),	<u> </u>		189000
NCE (0UT(1),RHOD),(0UT(2),WD),(0UT(3),0U),(0UT(4),WD)),(0UT(1),RDB),		/	099000
	1E) T4111) 2	<u>/</u>	6596 <u>00</u>
(Sd*(9T))_dN1) * (N*(859000
(INPT(25)*PDIFIS)*(INPT(26)*PDIFIA)*(INPT(37)*PDIFI7)* (INPT(28)*PDIFIS)*(INPT(29)*PDIFIA)*(INPT(30)*PDIFO)*	٤		Z99000

```
DATE 05 APR 72 PAGE
                   TAD.428249,2,100 .
                        CALL PHDENS(PIMP, HBIMP, 2, RHOID, RHOL, QUAL, JFLG)
000717
                        IF (JFLG.GT.1) RETURN
000718
                        IF (ABS(1.-RHOLD/RHOID)-1.0E-05) 150,150,100
000719
                       IMPELLER STATIC HEAD COEFFICIENT
000720
                   150 CALL PHIEMP(PDIFIA.HPIMP, 2.TID, 012, JFLG)
000721
                        IF (JFLG.GT.1) RETURN
000722
                        CALL PSENTH(PDIFIA:SS:2:HISIR:JFLG)
000723
                        IF (UFLG.GT.1) RETURN
000724
                        DHISI=(HISID-HSB) *778.16
000725
                        HN2IS=DHISI/M**2
000726
                        HCIS=32.174*DHISI/U2**2
000727
                        IMPELLER TOTAL HEAD COEFFICIENT
000728
                        HCIT=HCIS+(DI2/2./RPTAP)**2*(PSITH**2+PHI2**2)/2.
000729
                        DHITI=U2**2*HCIT/32.174
000730
                        HN2IT=DHITI/N**2
000731
                        EFIMP=HCIT/PSITH
000732
                        HOUSING HEAD LOSS COEFFICIENT
000733
                        DHCHG=HCIT-HCO
000734
                  С
                        DIFFUSER AND VOLUTE LOSSES
000735
                        CALL PSENTH(PDIFO, SS, 3, HISDB, JFLG)
000736
                        IF (JFLG.GT.1) RETURN
000737
                        DHISD=(HISD8-HSB) *778.16
000738
                        HN2DS=DHISD/N**2
000739
                        DIFFUSER DISCHARGE ANGLE BASED ON PFLEIDERS DEVIATION CRITERION
~000740
                        CM52=144.*(WS-WLBR)/RHOD/ADFD
000741
                        CUTH2=U2*PSITH
000742
                        AL52R=ATAN(1./(2.01+0.245*CUTH2/CM52))
000743
                        HVDF=.975*(CM52/SIN(AL52R))**2/(2.*32.174)
000744
                        DHITD=DHISD+HVDF
000745
                        HCTU=32.174*DHITD/U2**2
~000746
                        DHCDF=HCIT-HCTD
000747
000748
                        DHCVO=HCTD-HCO
                        RETURN
000749
                        END
000750
                        SUBROUTINE TAPE1
000751
                        COMMON / TITLE/ TESTID(12), DAY(2), RUNTME(2), IPAGE
000752
                        COMMON /TAPEIN/ CHAN1(100) + CHAN2(100) + CHAN3(100) + CHAN4(100) +
000753
                       1PARID(100) + CHANID(200) + UNITS(200) + DEC(200) + NPAR
000754
                        COMMON /TAPE/ TSTART. TSTOP. INT1. INT2. IAVE. NSETS, INPUT. ATIME. TIME.
~00u755
60u756
                       1 I END
                        INTEGER CHAN1, CHAN2, CHAN3, CHAN4, PARID, CHANID, UNITS, UN(100), D(100):
000757
                        REAL INPUT
ີ ແບບ758
                        DIBENSION INPUT (100,50), ATIME (50), DATA (200), NUM (10)
000759
                        INTEGER PGAGE
000760
                         INTEGER BLANK, F (22), G(22), V(14)
000761
                        INTEGER DEC. DAY, RUNTME, TESTID
000762
                        DATA BLANK /'
000763
                        TATA PGAGE VIPSIG IV
000764
                        DATA F(1).F(2).F(4).F(6).F(8).F(10).F(12).F(14).F(16).F(18).F(20).
000765
                       1F(22) /*(F9.1,*,10**F11.*,*)*/
000766
                        DATA V(1), V(3), V(4), V(5), V(6), V(8), V(9), V(10), V(11), V(13), V(14)
~000767
                       1/'(6X,', '(8X,13', 6H)/3X,', 6HTIME',, '3X,', '(5X,A6',
000768
                       26H)/4X, , 6HSEC1, 3, 1X, 1 (5X, A61, 1)/)1/
000769
                        DATA 6(22) 71)17
000770
                        DATA NUM/111,121,131,141,151,161,171,181,191,1101/
000771
005772
                        KENTR=1
                     100 READ(1) HCHAHATIME, "(DATA(1), I=1, MCHAN)"
006773
                         IF (TIME.LT.TSTART) GO TO 100
000774
                        BACKSPACE I
 306775
                         11. 11. 30 30 Sept
```

	TAD:428249:2:100 .	DATE 05 APR 72 PAGE 27	THE STATE OF THE S
000777	ENTRY TAPES		
000778	250 KENTR=2		
000779	260 NSETS=NSETS+1		
000780	00 270 J=1.NPAR	ı	
000731	/270 INPUT(J. NSETS)=0.0		
000782	ATIME(NSETS)=0.0		
600783	00 300 J=1.1!!T1		
000734	READ(1) MCHAM, TIME, (DATA(J), J=1, NCH	AN)	
000785	IF (KENTR.E0.1) GO TO 310	And the second s	
090786	IF (TIME.GE.TSTOP) GO TO 310		
000787	300 CONTINUE		
L90738	310 NAVE=1		
000789	320 ATTME (NSETS) = ATTME (NSETS) + TIME		*
CU0790 :	DO 350 J=1+NPAR		
000791	N=1	4	
C0U792.	K=CHAH1 (J)		<i>t</i>
000792,	PAR=DATA(K)		
000794	UN(J)=UNITS(K)		<u>:</u>
000795	D(J)=DEC(K)		· /
000796	IF (CHAN2(J).EQ.0) 60 TO 350	1	<u> </u>
000797	N=2		
000798	K=CHANS(J)		•
000799	PAR=PAR+DATA(K)		
	IF (CHAN3(J).E0.0) GO TO 350		•
000801	N=3		
0000012	K=CHAH3(J)		
000803	PAR=PAR+DATA(K)		
000804	IF (CHAN4(J).E0.0) GO TO 350	•	
000805	N=4		
000806	K=CHANH(U)	And the state of t	
000807	PAR=PAR+DATA(K)	•	
090808	350 INPUT (J. HSETS) = INPUT (J. NSETS) +PAR/N		
000509	IF (NAVE.GE.IAVE.OR.TIME.GE.TSTOP)	GO TO 450	
000610	. DO 400 I=1,INT2		
000811	READ (1) MCHAN, TIME, (DATA(J), J=1, NO	:HVN)	
000812	IF (TIME.GE.TSTOP) GO TO 410		
000813	400 CONTINUE		
000814	410 MAVE=NAVE+1		
000815	60 10 320	· · · · · · · · · · · · · · · · · · ·	
000816	450 DO 500 J=1.NPAR		
000817	IMPUT (J. MSETS) = IMPUT (J. MSETS) / MAVE		· · · · · · · · · · · · · · · · · · ·
000818	TE (HILL) TE PGAGE) GO TO 500		
100619	INPUT (J. NSETS) = INPUT (J. NSETS) + INPU	(1:NSETS)/2:036	. T. A.
000820	UN(J)='PSIA'		
000821	500 CONTINUE		
000822	ATIME(NSETS) = ATIME(NSETS) / NAVE		•
000823	IF (NSETS.LT.50.AND.TIME.LT.TSTOP)	60 TO 260	
000824	if (IEHD.EQ.O) RETURN		
000825	00 600 K=1/MPAR/19		
000826	IPAGE=IPAGE+1		
000827	L=K+9		
000828	NCOL=10	•	a
000829	IF (L.LE.NPAR) GO TO 550		
000030	L=nPAR		
000831	NCOL=NPAR-K+1		*
000832	550 V(2)=HUM(HCOL)		
900833	v(7)=HUM(NCOL)		. •
	V(12)=HUM(HCOL)		
006834	V(12)=:100:(1:0:00)		

000837	TAD:428249:2:100	
000837		4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	WRITE (6,V) (I,I=K,L),(PARID(I),I=K	(+L)+(UN(I)+I=K+L)
000838	/ M=1 ·	
000839	DO 580 I=K.L	
000840	/ M=M+2	
J00841	/580 F(M)=D(I)	
000642	00 582 I=1·M	
000843	582 G(1)=F(1)	
000844	IF (M.EQ.21) 60 TO 600	
000845	M1=M+1	
0.00846	DO 585 I=M1+21	
000847	585 G(I)=HLANK	
000848	600 WRITE (6.6) (ATIME(M).(INPUT(I.M).)	
000849 .	6000 FORMAT (12A6,12X, DATE 1,2A6, TIME	
ถังย850	6050 FORMAT (111,52X, LH2 PUMP TEST1,44)	X, 1PAGE 1, 14)
000851	RETURN	4
000852	END	
000853	C	
000854	C SPLINT CALCULATES INTERPOLATED POINTS	AND DERIVATIVES
000a55	C FOR A SPLINE CURVE	
000856	SUBROUTINE SPLNT (N:X:Y:EM:XX:YINT))
000857	DIMENSION 2(10), X(25), Y(25), EM(25)	
000858	1000 FORMAT (SPLNT USED FOR EXTRAPOLAT	TION: 3500 7/1
000859	MAX=1	1104.13520.171
000000	Z(1) = XX	
000861	001401=1,MAX	
000562	K=2	
030863	IF(Z(I)-X(1))70,60,90	
	60 YINT =Y(1)	
000864	SK=X(K)-X(K-1)	
600865		
J63000	60 TO 130	00.100
630867	70 IF $(Z(I)-(1.1*X(1)-0.1*X(2)))$ 75,12	50,1%0
000868	75 WRITE (6,1000) Z(1),X(1),X(2)	
030869	S[(W=16.	
0068 70	GO TO 120	
000871	80 K=N	A
โดยชี72	1F(Z(1)-(1.1*X(N)-0.1*X(N-1))) 120	9.120.85
006873	85 WRITE (6,1000) Z(T),X(N-1),X(N)	
0008 7 4 .	SR <i>s</i> =16	
000875	GO TO 120	· · · · · · · · · · · · · · · · · · ·
000876	90 IF(Z(I)-X(K))120,100,110	
0Ju877	100 YINT =Y(K)	
000578	SK=X(K)-X(K-1)	
000879	GO TO 130	
000880	110 K=K+1	
000831	IF(K-N)90,90,80	
000682	. 120 CONTINUE	
000883	SK=X(K)-X(K-1)	
000884	YINT = $EM(K-1)*(X(K)-Z(I))**3/6.$	7SK+EM(K)*(Z(I)-X(K-1))**3/6.
000885	1/SK+(Y(K)/SK-EM(K)*SK/6.)*(Z(I)-	X(K-1))+(Y(K-1)/SK-EM(K-1)*SK/6.
000886	2)*(X(K)-2(1))	
00688 7	130 DYDX =-EM(K-1)*(X(K)-Z(I))**2/2.	0 7\$K+EM(K)*(X(R-1)-Z(I))** 2/2
000888	1 /SK+(Y(K)-Y(K-1))/SK-(EM(K)-EM(K	-1))*SK/6•
000889	D2YDX=(X(K)-Z(I))*EM(K-1)/SK+(Z(I)	
000889	RCURV=((1,+DYDX**2)**1.5)/ABS(D2YD	
050890 050891	140 CONTINUE	🚧 in the control of
000892	500 PETUKN	
000493	END SUBROUTINE SPLNE (N.X.Y.EM)	
	· CIRCONTLLIED SPINE (DAYAYARM)	·
000594 000595	INTUGER SRW	

. . .

ستنبذ بالمتصور والمستعرفان

	TAD: 428249:2:100 DATE 05 APR 72 PAGE 29
00089 7 000898	C SPLINE CALCULATES FIRST AND SECOND DERIVATIVES AT SPLINE POINTS 3K C'END CONDITION-SECOND DERIVATIVES ARE THE SAME AT END POINT AND
000329	C ADUNCEIT POINT
000900	c /
006901	DIMENSION X(25),Y(25),EM(25),G(25),SB(25),SLOPE(25),CURV(25)
້ວນບານ2	SRV=0
000903	5D(1)=-1.0
000004	6(1)=0.
000905	no=n-1
000906	IF (110-2) 20,7,7
000907 .	7 D0101=2,400
000908	A = (X(1) - X(1-1))/6.
0000009	C=(X(I+1)-X(I))/6.
000410	W=2. *(A+C)-A*58(I-1)
000911	S8(1) =C7W 4
000912	$\hat{F} = (Y(1+1)-Y(1))/(X(1+1)-X(1))-(Y(1)-Y(1-1))/(X(1)-X(1-1))$
000913	10 G(I)=(F-A+G(I-1))/W
000914	20 EM(II)=G(N-1)/(1. +5B(N-1))
000915	D0361=3*N
000916	K=II+1-I
000917	30 FM(K)=G(K)+SB(K)*FM(K+1)
000918	SLOPE (1) = $(X(1)-X(2))/6$. *(2. *EM(1)+EM(2))+(Y(2)-Y(1))/(X(2)-X(1))
000519	1))
000920	D0401=2.N
000921	40 SLOPE(I)=(X(I)-X(I-1))/6. *(2. *EM(I)+EM(I-1))+(Y(I)-Y(I-1))/(X(
000922	11)-x(I-1))
000923	DO 45 I=1,N
000924	45 CURV(I)=((1.+SLOPE(I)**2)**1.5)/ABS(EM(I))
090925	IF (SRW) 50,100,50
000020	50 VRITE (6,1600) to (X(I),Y(I),SLOPE(I),FM(I),CURV(I),I=1,M)
ngn's //	100 to tool
0.00920	1000 FORMAT (*1*,1500. OF POINTS =+13/10X+1HX+19X+1HY+19X+5HSLOPE+15X+
000929	A2HEM, 15X, 4HCURV/(5E20.8))
- 000930	END
Cuu931	SUBROUTINE SATUR(N)
000932	COMPILER (DATA=SUORT)
000933	COMMON ZSATZ HSAT(25)+PSAT(25)+TSAT(25)+SSAT(25)+RHOSAT(25)+
099934	1EMPT(25), EMPS(26), EMTS(25), EMRS(25), EMRHOS(25), EMTP(25),
-000935	2HSATV(25), SSATV(25), RHOSTV(25), EMHLP(25), EMHLP(25), EMSLP(25),
000936	3EMSVP(25) + EMROLP(25) + EMROVP(25) + EMPH(25)
000937	Cres SATIRATION DATA
000933	DATA USAT /-132.81;-132.25;-129.29;-126.13;-122.79;-119.2;-115.38; C.
000939	1-111.31;-110.18;-106.96;-102.31;-97.32;-91.966;-86.208;-79.959;
0.00900	2-73 170665 73357-436-48-00936-376:-22-458:16-550/ *
000941	DATA PSAT 71.0214,1.1433,1.9546,3.1302,4.7762,6.9953,9.8904,13.564
006942	1,14.696,18.120,23.705,30.406,38.371,47.688,58.519,70.967,85.149,
000943	2101.21,119.30,139.63,162.40,187.51/
000945	DATA TSAT /24.845,25.2,27.0,28.8,30.6,32.4,34.2,36.0,36.482,37.8,
000945	130.6.41.4.43.2.45.8.45.8.48.6.50.41.52.21.54.01.55.81.57.61.58.3568/
000946	DATA SSAT /1.18491:1.20743:1.31999:1.43138:1.54157:1.65296:1.76315
000947	1,1.87572,1.90534,1.98628,2.10204,2.21816,2.33665,2.45751,2.58193,
000948	22.71227,2.84653,2.99428,3.15396,3.33553,3.56422,4.19696/
000949	DATA BHOSAT/4.8086;4.7975;4.7434;4.6884;4.6298;4.5693;4.5055;
- 000950	14.4371,4.4185,4.3664,4.2889,4.2086,4.1205,4.0256,3.9226,3.8086,
000951	23.6805:3.5350:3.3664:3.1578:2.8711:1.9619/
000952	DATA HSATV / 60.315.61.104.64.965.68.612.72.045.75.223.78.103.
000752	180.683781.498792.9877844.598786.207787.124787.539787.316786.3577
000554	284.439.81.472.76.866.69.891.58.502.16.358 /
	DATA SSATV / 8.9615.9.2821.8.5187/C.1936.7.9893.7.6545.7.4223.

.

5 (36) (05) (96) (76) (96) (96) (96) (96) (96) (96) (96) (9	э отт 8 5 0Т	510100
F (JELG.GI.1) GO 10 110	I	610100
VEL HPROP(PPAT) of 10 160 F (PPAT) of 10 160 F (PPAT) Of 10 160	1	totto.
(IVSa*II*Iawa*niIVa*I*I) 14 an - Tiv		110100
E. (bb*01*bCb11) 80 10 70S	I	maring maring
HINE:PICHIR		600100
NTRY PTENTR(PP.TT.K.ENTRO.JELG)	3	007000
No. LIMS		900100
ETURN WIRY FOR ENTROPY(PP,II)		900100
= (JFL6.61.1) 60 10 110		1/00700
ALL 19900 (PP.TT.N. 1.3. ENTH. JFLG. XMIN. XMAX)	707 C	001002
± (bb¹l¹b2V1) 60 10 (91 00 10 091 00 091 00 091 00 091 00 091 00 091 00 091 00 091 00 091 00 091 00 091 00 091	11	. 00100
(TARE THINGS RUINES TAKEN THE TAKEN	<u>``</u>	007007
= (pp.61,PCRIT) 60 T0 101	11	007000
4TR=*PTEMTH*		6660 0 0
VIRY PTENTH(PP.TI.K.ENTH.JFLG)	<u>.</u> 3	866000 266000
41RY FOR ENTHALPY(PP.11)		966000
TIAL BUB ENTHVI BX (55°11)		956000
>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	181	ti66000
: (7EFC*C1*1) CO 10 170	ΙI	266000
/TT_HBBQb(bb:\TI:SA:T:T:S:C:AEG:XWIN:XWYX)	10 001	
: (pp.t1.PsAt) 60 t0 160	i.	166900
/FF SBFMI(MYLZVI)BYEMBIYII*BZVI).	13 -	. 066000
		66500 <u>0</u> 886000
		789000 449,466
ITKY PTDEMS(PP.TT.K.RHO.JFLG)	1.3	986000_
TRY POINT FOR DENSITY(PP.TT)	13 5	91-6000
VSSVI AT	ia -	1186000
AA PCRIT /187.55	/dD	£86000
IZAB (S2) • ENGOLD (S2) • EMBOAD (S2) • EMBH (S2)	4BC	0,00888
YIAB (SQ) * 22VIA (SQ) * BHO2IA (SQ) * EWHEB (SQ) * EWHAR (SQ) * EWPER (SQ) *	SHZ	000087
12(S2)*E4B5(S2)*E4B2(S2)*E4B42(S2)*E4B4027S2**	N.3 i	62 69 90 03 60 90
MMM VAZA HSATUR(SS) PSATUR(SS) TSAT(SS) PRHOSAT(SS) .	UJ NVT	879000
(6,90), RHOX (90), B(9,8)	77	446000
□PON \PROPI (30.50).5√(30.50).H(30.50	ns.	926000
	N.B	97.6900
NAUT		#Z6000
rr serije (M.Psvi.ghosiv.empovP)	٧̈́Ĵ	ይ ፈ6000
FF SBFUE (M'BSVI'BHOSVI'EWBOFB)	CV	, \$7,6000
TT_SETINE_(B)*BSV1*82V1*EWSAB) /	∀ J	TZ6000
C SAFRE (A-SEVI-SEVI-SEVI-SEVI-SEVI-SEVI-SEVI-SEVI		. 076900 686000
FF SEFEC (MIDSVINISHINE)		896000
CF_2bFUE_(M*82VI*NRVI*EMNFb) FC_2bFUE_(M*82VI*NRVI*EMNFb)	v ɔ	Z96000
LL SPLUE(W.SSAT. HASAT. EMBHS)	v o	996000
LL SPLNE (N.SSAT. TSAT. EMIS)	V O	ვოგიიიე
(GTM3-17A7-1529-0) PULAS LL (21V3-17A7-17A7-17A7-17A7-17A7-17A7-17A7-17A	CV	496000
· (Pahatiasti) Bluss (I) Philips (I) Phili	AD.	896000
TEL_ZBELIE (II) HSAT*PASAT*EMPH)	10	<u> </u>
TF 28F13C(N*12V1*E281)	_ CV.	196000
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	213	
A MINOST VIOLE 100 105 12927 12927 12031 12031 12031 12031 12031 12031 12031 13031 1	V 1 /	856000
\$310.269.5.658.5.2492.4.490270.4.3946\ \$45868.5.07390.4.656.4.09270.4.99270.4.09270.4.095093.4.120149	*82 /	, ZS6000
549.2.100	92440VI	
DATE OS APRES 30	00 / U. Z	•

	TAD:428249:2:100 .	DATE 05 APR 72 PAGE 31
201017	120 WRITE (6.2000) XMIN.XMAX.PP.ENTR.K	
001017	DUOD EODMAT : (* MINIMUM TARULATED PRESSURE	IS GREATER THAN P'/
001018	1. PMIN='.F10.2.5X.'PMAX='.F10.2.5X.'P	-*,F10.2,5X,A6,12)
001019	/ RETURN	
001020	ASA WOTTE 15.2010) YMIN.YMAY.PP.FNTR.K	
001021	2010 FORMAT (MAXIMUM TABULATED PRESSURE	IS LESS THAN P'/
001022	1. PMIN=",F10.2,5X, 'PMAX=",F10.2,5X, 'P	=1.F10.2.5X.A6.12)
001023	RETURN	
001024	THE WELT'S (6.2020) YMYN. XIIAX. TI. ENTR. K	
001025	onen FORMAT (* MINIMUM TABULATED TEMPERATU	RE IS GREATER THAN T'/
001026	1' TMIN=',F10.2.5X.'TMAX=',F10.2.5X.'T	= ' · F10 · 2 · 5X · A6 · I2)
001027	RETURN	
-601028	IND WOTTE (C. DUBO) YMTH.YMAX.TT.FRNTR.K	
001029	ONTO CORMIT (* MAXIMUM CABULATED JEMPERATU	RE IS LESS THAN T'/
001030	1. THIN= .F10.2.5X. TMAX= .F10.2.5X. T	=',F!0.2,5X,A6,12) 4
001031	RETURN	
001032 .	tan WRITE (n.2040) PSAT-PP-ENTRIK	
001033	2040 FORMAT (P IS LESS THAN SAT. PRESS.	CORRESPONDING TO T'/
001034	1* PSAT=*,F10.2.5X.*P=*,F10.2.5X.A6.I2)
001035	JFL6=6	
001036	RETURN	
001037	C ENTRY FOR TEMPERATURE (PP+HH)	
001038	C ENTRY FOR TEXA ENGINEERY	
001039	ENTRY PHTEMP (PP. HH, K, TEMP, X, JFLG)	•
001040	ENTR="PHTEMP"	
001041	IF (PP.GT.PCRIT) GO TO 200	
001042	CALL SPENT (N. HSAT, PSATUR, EMPH, HH, PSAT)
001043	IF (PP.LT.PSAT) GO TO 260	
001044	200 CALL HOROP (PP. HH. T. H. 3.1. TEMP. JELG. XI	(N, XMAX)
601045	IF (JFLG.GT.1) GO TO 210	
(01046		
01047	X=0+0 RETURN	
C J1048		
001049	C ENTRY FOR DENSITY (PP) PRITE	
C01050	ENTRY PHOENS (PP.HH.K.RHO.RHOL.X.JFLG	
CU1051	FNTR='PHOENS'	
001052	IF (PP.GT.PCRIT) GO TO 201	
001053	CALL SPENT (N. HSAT, PSATUR, EMPH, HH, PSA	ĵ)
001054	IF (PP.LT.PSAT) GO TO 280	
001055	201 CALL HPROP (PP+HH-SV-H-3-2-C-JFLG-XMI	(XAMX)
001056 001057	IF (UFLG.GT.1) 60 TO 210	
	RH0=1./C	
001058	X=0.0	
001059 001060	RHOL=0.0	
	RETURN	
001061	C ENTRY FOR ENTROPY (PP, HH)	
001062 001063	C LINE ON WITHOUT TO	
	ENTRY PHENTR (PP, HH, K, ENTRO, JFLG)	
001054	ENTR='PHENTR'	
001065 001066	TE (PP.GT.PCRIT) 60 TO 208	
	CALL SPLINT (N. HSAT, PSATUR, EMPH, HH. PSA	r)
001067	TE (DP. 1 T. PSAT) GO TO 290	
001068	202 CALL HPROP (PP. HILLS . H. 3.4 ENTRO . JELG.	XMIN.XMAX)
001069 001070	IF (JFLG.GT.1) GO TO 210	
	205 RETURNS	
001071 001072	210 GO TO (205,120,130,240,250), JFLG	
GOIGIE	AND COLOR TO A SHOULD YMIN YMAX ARULAR BIRAK	, ve
003075		
001073 001074	3000 FORMAT (* MINIMUM TABULATED ENTHALP) 1. HATH=:,F10.4,5%,*HMAX=:,F10.4,5%,*	IS GREATER THAN HYZ

•

~		
<i>)</i>	TAD:428249:2:100 ·	DATE 05 APR 72 PAGE 32
1 001077	250 WRITE (6,3010) XMIN, XMAX, HH, ENTR, K	
001078	3010 FORMAT (* MAXIMUM TABULATED ENTHALPY IS LESS TH	AN H'/
001079	1' HMIN=',F10.4,5X,'HMAX=',F10.4,5X,'H=',F10.4,5	X,A6,12)
3 001080	/ RETURN	
3 001081	/260 CALL SPLNT(N+PSATUR+HSAT+EMHLP+PP+HSATL)	
001032	CALL SPLNT(N, PSATUR, HSATVP, EMHVP, PP, HSATV)	
\$ 001083	CALL SPLINT (N. PSATUR, TSAT, EMTP, PP, TEMP)	
001084	IF (HH.GT.HSATY) 60 TO 270	
001085	X=(HH-HSATL)/(HSATV-HSATL)	
ð 001086	RETURN	
001087 -	270 WRITE (5,3020) PSAT,PP,HSATV,HH,ENTR,K	
001088	3020 FORMAT (P IS LESS THAN SAT. PRESS. CORRESPOND	ING TO H AND H IS G
3 001089	TREATER THAN H SATURATED VAPOR 1/ PSAT= 1. F10.2.5	X,*P=*+F10+2+5X+
001090	2*HSATV=*,F10.4.5X,*H=*,F10.4.5X,A6,I2)	
001091	JFLG=6	4
001092	RETURN .	. The contract of the contract of f
001093	280 CALL SPLNT(N.PSATUR.RHOSAT.EMROLP.PP.RHOL)	
001094	CALL SPLHT (N. PSATUR, RHOSTV, EMROVP, PP, RHOV)	
001095	CALL SPINT (N. PSATUR, HSAT, EMHLP, PP, HSATL)	. The contract of the contract of I , which is the I -state of I -state I -stat
001096	CALL SPENT (N. PSATUR, HSATVP, EMHVP, PP, HSATV)	
001097	IF (HH.GT.HSATV) GO TO 270	
001098	X=(HII-HSATL)/(HSATV-HSATL)	
001099	RHU=RHOL*RHOV/(X*RHOL+ (1X)*RHOV)	
301100	RETURN	
3. 001101	290 CALL SPENT (N. PSATUR, SSAT, EMSEP, PP, SL)	
001102	CALL SPLMT (N. PSATUR, SSATV, EMSVP, PP. SVP)	
001103	CALL SPLNT(N.PSATUR, HSAT, EMHLP, PP, HSATL)	•
001104	CALL SPLINT (N. PSATUR, HSATVP, EMHVP, PP, HSATV)	
001105	IF (HH.GT.HSATV) GO TO 270	
001106	XS=(HH-HSA)L)/(HSATV-HSATL)	
්. 0011U7	ENTRO=XS*SVP+(1XS)*5L	
001108	RETURN	
001109	C ENTRY FOR ENTHALPY (PP.SS)	
001110	c	
001111	ENTRY PSENTH(PP+SS+K+ENTH+JFLG)	
001112	ENTR= PSENTH*	
001113	IF (PP.GT.PCPIT) GO TO 300	
001114	CALL SPENT(N,SSAT,PSATUR,EMPS,SS,PSAT)	
001115	1F (PP.LT.PSAT) GO TO 360	8
001116	300 CALL HPROP(PP:SS:H:S:4:3:ENTH:JFLG:XMIN:XMAX)	
001117	IF (JFLG.61.1) GO TO 310	
001118	305 RETURN	
001119	310 GO TO (305,120,130,340,350), UFLG	
001120	340 WRITE (6,4000) XMIN, XMAX, SS, ENTR, K	•
001121	4000 FORMAT (MINIMUM TABULATED ENTROPY IS GREATER	THAN S'/
§. 001122	1. SMIN=+.F10.5.5X, SMAX=+.F10.5.5X, S=+.F10.5.5	X+N6+12)
001123	RETURN	
001124	350 WRITE (6,4010) XMIN, XMAX, SS, ENTR, K	
🐉, 001125	4010 FORMAT (MAXIMUM TABULATED ENTROPY IS LESS THA	
001126	1. SMIN=",F10.5,5X, 'SMAX=",F10.5,5X,'S=",F10.5,	57.016.12)
001127	RETURN	
001128	360 CALL SPENT(N:PSATUR:HSAT:EMHLP:PP:HSATE)	
001129	CALL SPENT (N. PSATUR, HSATVP, EMHVP, PP, HSATV)	
901130	CALL SPENT (N. PSATUR, SSAT, EMSEP, PP, SL)	
3. 001131	CALL SPLIN (N.PSATUR.SSATV.EMSVP.PP.SVP)	
001132	IF (55.61.5VP) GO TO 370	TO THE OWNER OF THE PROPERTY O
圖 001133	XS=(SS-SL)/(SVP-SL)	ran ran va
麗。 001134	ENTH=XS*HSATV+(1XS)*HSATL	
36 .001135	RETURN	The support of the su
Sign and the second	370 PRITE (6.4020) POAT.PRISUPISS.FRITR.K	

	TAD:428249:2:100 ,	DATE 05 APR 72 PAGE 33
001137	4020 FORMAT (* P IS LESS THAN SATE PRES / IREATER THAN S SATURATED VAPOR*/* I	SS. CORRESPONDING TO S AND S IS G
091138	/ 1REATER THAN S SATURATED VAPOR*/* / 2*SV=**F10*5*5X**S=**F10*5*5X*A6*13	A2V12.110.51.2V1.LT.1.LT.0.51.2V
001139	JFLG=6	ar
001140	RETURN	•
001141		
001142	C**** THIS SUBROUTINE READS IN THE HYDR	OGEN PROPERTIES DATA TO BE USED FILE 001
001143		FILE CO2
001144	C**** IN SUBROUTINE HPROP	FILE 003
001145	C CUITANT TURBOR	Table 1000
001146	SUBROUTINE INPROP	
001147	DIMENSION A(30)	11/70 FOX 5/70 FOX NUM/70\-D/30\-
001148	COMMON! /PROP/ T(30.50),SV(30.50),	H(30)30)+5(30)30)+NOM(30)+F(30)+
001149	1AA(5,90),RHGX(90),B(9,8)	FILE 009
001150	10 FORMAT (0F10.0)	FILE 010
001151	20 FORMAT (2513)	F-1 F 0+4
001152	C	FILE 011
601153	C**** READ NUMBER OF DATA POINTS FOR EA	CH ISONAR FILE 012
001154	C	FILE 013
001155	READ (5,20) (NUM(I),I=1,30)	
001156	DO 50 I=1.30	
001157	M=NUM(I)	FILF 016
001158	C	FILE 017
001158	C**** REAU TEMPERATURES FOR ISOBAR I	FILE 018
001100	C	FILE 019
001161	READ (5:10) (T(I:J):J=1:M)	
001161	C	FILE 021
	C**** READ SPECIFIC VOLUMES FOR ISOBAR	file 022
001163	C C C C C C C C C C C C C C C C C C C	FILE 023
001164	•	·
001165	READ (5.10) (SV(I.J), J=1.M)	FILE 025
001 Lon	C	111 026
00) 167	C++++ HEAD CHHIALPYS FOR ISONAR I	FILE 027
99116B	C	FILE US!
001169	READ (5,10) (H(I,J),J=1,N)	
001170	C	FILE 059
001171	C**** READ ENTROPYS FOR ISOPAR I	FILE 030
001172	C	FILE 031
001173	50 READ (5:10) (S(I:J):J=1:M)	and the second of the second o
001174	c	FILE 037
001175	C**** CONVERT PRESSURES FROM ATMOSPHERE	S TO PSIA FILE 038
001176	C ·	FILE 039
001177	Λ(1)=1.	FILE 0#.0
001178	Λ(2)=1.5	PILC 041
201179	DO 55 I=2.10	FILE 042
001130	55 A(I+1)=I	FILE 043
001181	Λ(12)=12.5	FILE 044
001181	DO 60 I=1.6	FTLF 045
	60 A(I+12)=10+5*I	FILE 046
001183	00 A(1+)2/210/341 00 65 I=1.5 .	FILE 047
001184	65 A(I+20)=50+10*I	FILE 048
001185		
001186	00 70 I=1.5	
001187	70 A(I+25)=100+20*I	
001138	DO 80 I=1.30	FILE 050
001189	80 P(I)=14.696*A(I)	FILE 057
001190	25 FORMAT (5E16.7)	FILE 058
001191	30 FORMAT (10F8.4)	FILE 059
001192	35 FORMAT (9E20.8)	
001193	C	F1LE 060
001194	C**** READ EMPIRICAL COEFFICIENTS	FILE 061
001195	C	FILE 062

	TAD,428249,2,100 . DATE US	1	•
001197	READ (5.30) (RHOX(I).I=1.90)		
001198	/ READ (5,35) ((B(I,J),J=1,8),I=1,9)	FILE 066	
001199	RETURN	FILE UGO	
001200	END END	HPROPODO	
001801	C**** SUBROUTINE HPROP **** C**** THIS SUBROUTINE PROVIDES THE FOLLOWING HYDROGEN PROPERTIES DATA		
001202		HPROPO02	
001203	C**** THE MAIN PROGRAM: C**** SUCTION LINE SPNIC VELOCITY AS A FUNCTION OF TEMPERATURE AND	HPROPO03	
001204		HPROPO04	
001205	C**** PRESSURE C**** INDUCER INLET SPECIFIC VOLUME AS A FUNCTION OF TEMPERATURE AND	HPROPO05	•
001206		HPROPO06	
001207	C**** PRESSURE C**** PUMP INLET SPECIFIC VOLUME AS A FUNCTION OF TEMPERATURE AND	HPROPON7	
001208		HPPOP008	
001508	C**** PRESSURE	HPROPOOS	•
001210	C SUBROUTINE HPROP(A, B, Y, X, KJ, K, C, JFLG, XMIN, XMAX)	4	
001211		1	
001212,	DIMENSION X(30,50),Y(30,50),CP(2) COMMON /PROP/ T(30,50),SV(30,50),H(30,50),S(30,50),N(30),P(30),		
001213	COMMUN. VEKGEN 1 (2012) 1/2 / (
001214	1AA(5,90), RHOX(90), D(9,8)		
001215	COMMUN /SAT/ HSAT(25):PSAT(25):TSAT(25):SSAT(25):RHOSAT(25):		
001316	1CMPT (25), CMPS(25), EMTS(25), EMHS(25), EMRHOS(25), EMTP(25), 2HSATV(25), SSATV(25), RHOSTV(25), EMHLP(25), EMHVP(25), EMSLP(25),		
001217	2HSATY (25) + SSATY (25) + RIOSTY (25) + EMBLEY (25) + EMBOLEY (25) + EMBOLEY (25) + EMBOLEY (25) + EMBOLEY (25)		•
001218		FIPROPO12	
001219	C C C C C C C C C C C C C C C C C C C	HPROP013	
001220	C**** P IS THE PRESSURE ARRAY	HPROP014	•
001221	C**** X IS THE INDEPENDENT PROPERTY ARRAY C**** Y IS THE DEPENDENT PROPERTY ARRAY	HPROPO15	
001222	C**** N IS THE OF DATA POINTS FOR EACH ISOBAR ARRAY	HPPOP016	
001223	C*** N 15 THE OF DATA POINTS FOR EACH 130BAR ANACT	HPROP017	
001224	C**** A IS PRESSURE C**** B IS THE SECOND INDEPENDENT VARIABLE	HPROP018	•
001225	C*** KU DETERMINES THE INDEPENDENT PARAMETER USED	HPROP019	
031226	C**** KU=1,8 IS TEMPERATURE	HPROP020	•
091227	C*** KU NOT=1.8 IS SPECIFIC VOLUME ENTHALPY ENTROPY OR SONIC VELOCIT	Y HPROPO21	
001228	C**** K DETERMINES THE DEPENDENT PARAMETER REQUESTED	HPROP022	
001229	C**** K=1.C IS TEMPERATURE	HPROP023	
001230	C**** K=2*C IS SPECIFIC VOLUME	HPROP024	
001231	C**** K=5.C 15 ENTHALPY	HPROP025	
001232	C**** K=4+C IS ENTROPY	HPROP026	•
001233 001234	C**** K=5.C IS SUNIC VELOCITY	HPROP027	
	C**** C IS THE REQUESTED DEPENDENT PROPERTY	· HPROPO28	7
001235	C**** D IS THE ARRAY OF EMPIRICAL CONSTANTS USED IN THE SATURATED	HPROP029	
001236	C**** PRESSURE SUBPROGRAM SVSL	HPROP030	
001237 001238	<u> </u>	* HPROP031 *	
001239	NSAT=22		
001240	JFL6=1	HPROP032	
001240	1=0	HPROP033	
001242	LIMIY=0	HPROP034	•
001242	C	HPPOP035	
001245	C**** SET XMINEMINIMUM TABULATED PRESSURE	HPROP036	
001245	c c	. HPROPOST	
001246	XMIN=P(1)	PPROP038	
001247		HPP0P039	
001248	C**** SET XMAX=MAXIMUM TABULATED PRESSURE	HPROP040	<u>s</u>
001249	Č	HPROPO41	The state of the s
001250	XMAX=P (25)	HPP0P042	
001251	50 I=I+1	HPROPO43	
001252	C	HBB0B0##	The state of the s
001253	C**** SEARCH PRESSURE TABLE FOR VALUE CORRESPONDING TO A	HPROP045	, and , and , control of the .
001254	C	HPPOP046	
001255	IF(P(I)-A) 60.80.55	HPROPO47	

;

	TAD:428249:2:100 .	DATE 05 APR 72 PAGE 35
001257	C**** TABULATED PRESSURE IS GREATER THAN A.TEST FOR MINIMUM TAR	
001258	C	HPROP050
001259	55 IF (I-1) 200,200,150	HPROPOS1
001260	C /	HPROPOS2
001201	C**** TABULATED PRESSURE IS LESS THAN A TEST FOR MAXIMUM TABLE	
001262	C	HPR0P054 HPR0P055
001263 001264	60 IF (I=25) 50,250,250	HPPOPOS6
001264	C**** TABULATED PRESSURE=A	HPROP057
001266	C	HPROP058
001267	80 M=N(I)	HPROP059
001268	C	HPPOPO60
001269	C**** SET XMIN=MINIMUM TABULATED INDEPENDENT PROP.	HPROPO61
001270	C	HPROP062 .
001271	XMIN=X(I,1)	нрпороба
001272,	C	HPPOPOGE
001273	C**** SET XMAX=MAXIMUM TABULATED INDEPENDENT PROP.	HPP0P065 HPP0P066
001274	C XMAX=X(I•M)	HPROPO67
091275 001276	XMAX=X(1+M) J=0	HPROPO68
001276	85 J=J+1	HPROP069
001278	C .	HPROP070
001279	C**** SEARCH INDEPENDENT PROPERTY TABLE FOR VALUE CORRESPONDING	
001280	C	HPP0P072
001281	IF (X(I,J)+B) 95,100,90	HPROP073
001232	C	HPR0P074
001283	C**** TABULATED PROP. IS GREATER THAN B. TEST FOR MINIMUM TABLE	VALUE HPROPO75
001284	00.75 (1.1) 700.700.110	HPP0P076 HPR0P077
001285	90 IF (J-1) 300,300,110	HPROPO78
001286 091287	C C**** TABULATED PROP. IS LESS THAN BITEST FOR MAXIMUM TABLE VAI	
001288	C C	HPROPONO
001289	95 IF (J-M) 85,350,350	
001290	c	HPPOP082
001291	C**** TABULATED PROP=8.SET C=TABULATED VALUE	HPROP083
001292	C	HPROPOS4
001293	100 C=Y(I,J)	HPROPORS
001294	GO TO 500	HPR0P086 HPR0P087
001295 001296	C**** INTERPOLATE ALONG ISOBAR I FOR C	HPROPOR8
001298	C	HPROPOSS -
001298	110 C=Y(I,J-1)+(B-X(I,J-1))/(X(I,J)-X(I,J-1))*(Y(I,J)-Y(I,J-	
001299	GO TO 500	HPROPOO1
001300	C	HPP0P092
001301	C**** A LIES BETWEEN TWO TABULATED ISOBARS, INTERPOLATE ALONG E	ACH, ISOBARHPROPUSS
001302	C**** FOR PROPER B	HPR0P095
001303	C 150 NM=1-1	HPROPO96
001304 001305	150 NM=1-1 DO 160 IK=NM•I	HPR0P097
001305 001306	MEN(IK)	HPROP098
001307	JK=IK-I+2	HPROP099
001308	J≡U	
001309	C	HPROPIN1 *
001310	C**** SET XMIN=MINIMUM TABULATED INDEPENDENT PROP.	HPROP102
001311	C '	HPROPIN3
2 361312	XMIN=X(IK+1)	HPPOP104
001313	COLLEGE OF MANAGEMENT TARMS ATER TARREDUM DENT DRAP	HPROPIOS HPROPIOS
001514	C**** SET XMAX=MAXIMUM TABULATED INDEPENDENT PROP.	HPROPING
961315	•	P0300101

		TAD:428249:2:100 . DATE 05 A	PR 72 PAGE 36
0013		155 J=J+1	HEROP109
0013			HPROP110
0013		C**** SEARCH INDEPENDENT PROPERTY TABLE FOR VALUE CORRESPONDING TO B	HPROP111
0013		C /	HPROP112
0013		IF (X(IK,J)-B) 165,170,160	HPROP113
0013		C	HPPOP114
0013		C**** TABULATED PROP. IS GREATER THAN BITEST FOR MINIMUM TABLE VALUE	HPROP115 HPROP116
0013		C	HPPOP117
0013		160 IF (J-1) 300,390,550	HPROP118
.0013	526	C TOTAL TOTAL TOTAL TOTAL TABLE VALUE	HPROP119
0013	327 <u> </u>	C**** TABULATED PROP. IS LESS THAN BITEST FOR MAXIMUM TABLE VALUE	HPR0P120
0013	328	C	HPP0P121
0013		165 IF (U-N(IK)) 155:510:510	HPROP122
0013		C CONTROL ATTO MALLE	HPROP123
0013		C**** TABULATED VALUE=B.SET CP=TABULATED VALUE	HPROP124
0013		C	HPR0P125
0013		170 CP(JK)=Y(IK,J)	HPROP126
0013		60 TO 180	HPPOP127
0015		C C**** MAXIMUM TABULATED VALUE IS LESS THAN B. IF ISOBAR LESS THAN A SET	HPP0P128
0013		C**** MAXIMUM TABULATED VALUE IS LESS THAN A SET ERROR FLAG AND C**** LIMIT=1 AND CONTINUE, IF ISOBAR GREATER THAN A SET ERROR FLAG AND	HPROP129
0013		C**** EIMILET WIN CONFINCEALL IROUGH ORGANISM LAWE A RELATION	HPROP130
0013		C C	HPROP131
0013		510 IF (UK-1) 520,520,350	HPROP132
0013		520 LIMIT = 1	HPROP133
0013			
0.013		GO TO 180	HPROP135
0013		C**** CHECK LIMIT SET=1	HPROP136 .
0013	-	C C C C C C C C C C C C C C C C C C C	HPPOP137
0013		550 IF (LIMIT) 175,175,600	HPROP138
001.		•	HPROP139
0013		C**** LIMIT=0, NORMAL INTERPOLATION SEQUENCE ON ISOBAR	HPROP140
0013			HPROP141
0013		175 CP(JK)=Y(IK.J-1)+(B-X(IK.J-1))/(X(IK.J)-X(IK.J-1))*	HPROP142
001		1(Y(IK,J)-Y(IK,J-1))	HPR0P143
-001		180 CONTINUE	HPROP144
001		$oldsymbol{c}$. The first contribution of the $oldsymbol{c}$	HPROP145 HPROP146
0013		C**** NORMAL INTERPOLATION FOR C	*HPP0P147
001	355	C	HPROP148
001	356	C=CP(1)+(A-P(I-1))/(P(I)-P(I-1))*(CP(2)-CP(1))	HPROP149
001	357	GO TO 500	* HPPOP150 *
001		C THE THE THE THE AC INCEPTION TO PROPERTY	HPPOP151
301		C**** LIMIT=1. CHECK FOR TEMPERATURE AS INDEPENDENT PROPERTY	HPROP152
001		C	
001		600 IF (KU.EO.1) 60 TO 610	•
	362	IF (KJ.E0.3) GO TO 611	
	353	IF (KJ.EQ.4) GO TO 612	
	364	GO TO 350	HPROP154
	.365	C C**** TEMPERATURE IS INDEPENDENT PROPERTY FIND CORRESPONDING VAPOR	HPROP155
	.366	C**** PRESSURE	HPROP156
	.307	•	HPROP157
	368	C 610 CALL SPENT(NSAT, TSAT, PSAT, EMPT, B, PSE)	3
	1369	60 TO 615	
	(370	611 CALL SPLHT (NSAT+HSAT+PSAT+EMPH+B+PSL)	
	1371	CO TO 615	
	1572	612 CALL SPLIT (NSAT, SSAT, PSAT, EMPS, B, PSL)	The same of the sa
	373	612 CALL SPEIN (NOME FOR A SALE) STORE STATE STA	-
	1374		HPPOP160
(11)	1375	CALLE FIED STARBATED LIGHTO SPEC. VOL. CORRESPONDING TO TEMPERATUREER	HPROP161

~

45 - 4 - 4 - 10 - 100 - 107		HPROP162	
001377	C 620 CALL SPENT(NSAT, PSAT, RHOSAT, EMROLP, PSL, CP(2))	TERUE 102	
001378	/ CP(2)=1./CP(2)		
001379 001380	/ GO TO 650	HPROP164	
J01381	c/ 00 10 0 30	HPROP165	
001381 001382	C**** FIND SATURATED LIQUID ENTHALPY CORRESPONDING TO TEMPERATURE=B	HPROP166	
001383	C.	HPROP167	•
001384	630 CALL SPLIT (NSAT, PSAT, HSAT, EMHLP, PSL, CP(2))		
001385	60 TO 650	HPROP169	
001336	c	HPROP170	
001337 .	C**** FIND SATURATED LIQUID ENTROPY CORRESPONDING TO TEMPERATURE=B	HPROP171	
001388	<u>C</u>	HPROP172	
001339	640 CALL SPLNT(NSAT, PSAT, SSAT, EMSLP, PSL, CP(2))	LIDDOD 17"	
601390	60 10 650	HPROP174 HPROP175	
001391	C CONTRACTOR A TOUR CONTRACTOR	HPROP175	
001392	C**** SET SATURATED LIQUID SONIC VELOCITY	HPROP177	
001393	C (05 CD(2) = 3000	HPROP178	
001394	645 CP(2)=3940.	HPROP179	
001395	C**** INTEPOLATE FOR CP ON ISOBAR GREATER THAN A	HPROP180	
_001396	AMELIA FAREFACTE SIXE OF AN EXAMINATION CONTROL OF THE PROPERTY OF THE PROPERT	HPPOP181	
00139 7 001398	650 CP(1)=Y(I,J-1)+(B-X(I,J-1))*(Y(I,J)-Y(I,J-1))/(X(I,J)+X(I,J-1)		
001399	c	. Hbsob183	
001399	C**** INTEPOLATE FOR C USING SATURATED COMPITIONS	HPROP184	•
001401	C	HPROP185	
001402	C = CP(1) + (A - P(1)) * (CP(2) - CP(1)) / (PSL - P(1))	HPROP186	
001403	GO TO 500	HPROP187	1
001404	c	HPROP188 .	* .
กบา405 -	C**** MINIMUM TABULATED PRESSURE IS GREATER THAN A.SET ERROR FLAG	HPROP189	
001496	C C C C C C C C C C C C C C C C C C C	HPPOP190	
001407	200 JFLG=2	HPR0P191 HPR0P192	
001408	GO TO 500	HPROPIOS	
001409	C	HPROP194	
001410	C**** MAXIMUM TABULATED PRESSURE IS LESS THAN A*SET ERROR FLAG	HPPOP195	
_001411	C (50 (51 0-2)	HPROP196	· · · · · · · · · · · · · · · · · · ·
001412	250 JFLG=3	HPP0P197	
001413	GO TO 500	HPROP198	
001414 001415	C**** MINIMUM TABULATED INDEPENDENT PROP. IS GREATER THAN B.SET ERR		3.
001416	C**** FLAG	HPROP200	Y
001417	C	: HPROF201	
001417	300 JFLG=4	, RUBUBSUS ,	
001419	60 TO 500	HPROP203	
001420		HPROP204	
001421	C**** MAXIMUM TABULATED INDEPENDENT PROP. IS LESS THAN B.SET ERROR	FLAG HPROP205	
001422	$oldsymbol{c}$	HPROP206	
001423	350 JFLG=5	HPROP207	
001424	500 RETURN	HPPOP208	
001425	END	. MEROLEO	
001426	NTAGS 10		
001427	TAPE 1.18' . KEN KIRK 'S TAPE		
001428	TAPE 2. 'K' . OUTPUT TAPE FOR KIRK.		<u> </u>
001429	READ 5		
001430 .	PRINT 6		
001431	End Comment of the Co	,	
2.		11:	08:28
۷.			C2n

Company and the product of the produ	· ·
	•
	Programme and the control of the con
• • •	
	ADDITIONAL INFORMATION ON (2) & (3) BUNNATERIOR JANOITIGOA
TERESTED USERS BY CONTACTING YOUR SALESMAN AT 415-562-4204.	MI THE OI 3 IN MOIL 31 (5) a (6) HE HELD
	USE OF THE GOPH KEYIN WILL TURN PARITY CHECKING ON.
BE DONE AUTOMATICALLY.	EX VERT 6. 1972 PARTY CHECKING ON ROWN INPUT MULL NOT
	*** 7101/1 ***
	179-299-91th
	V 2011 0 11 11 11 11 11 11 11 11 11 11 11 1
	#17-295-01# OT 950#-29E
	#12=862=4036 10 CHAR/SEC
LISTED BELOW.	THE DIAL UP PLEETHONE TUMBERS AND TRANSMISSION RATES ARE
ED TELETYPE COMPATIBLE TERMINALS USING DIAL-UP COMMUNICATION LINES.	ALV YER AND ALV AND HOLD HOLD HOLD AND AND AND AND AND AND AND AND AND AN
	(S) TYRGE-COVE (TCH) PRODUCTION JOBS ARE NOW BEING ROW DAY AN
OVERVIOUS BASIS STARTING AT 04:00 EACH DAY	
• • • • • • • • • • • • • • • • • • • •	00.00
	MON: 00:00 = 00:00 1 00:00 = Sπ:00
	00.48 - 00.20
	(I) IZO IIOR IERWINYE ZEKATCE 12 ZCHEDOTIO W CHATCH
	*** OZEK NOLICES - VERIL 5, 1972 ***
·	
PRIOR WRITTEN AUTHORIZATION BY ISD.	THEOBAYTION OF 12D AND 15 NOT TO BE COPIED OR REPRODUCED WITHOUT
IY FORM WHATSOEVER, IS PROPRIETARY	OSE OF THE SWPIN KEYIN WILL TURN PARITY CHECKING ON, 1. ADDRESS STATES
	bvoes= 21. TIMES= SISS. TIME=08:00:09 (MMS)
0 =100 498	05 APR 72 P 11:08:28 IDENT=TAD ACCOUNT=428249 CARDS IN= 20
5	
	VEDDITIONAL INFORMATION ON (2) A (3) IS NOW AVAILABLE TO ALL INTERESTED USERS BY CONTACTING YOUR SALESHAND AT 41 THE SALESH WITH ALL THRW PARTITY CHECKING ON. 12 SALESH SALES AND SALESH SALE
1HA ABCDEFGHIJKLMNOPORSTUVWXYZ)-+<=>65*(%;?!•\0123456787*√. GLJHA	30 /*/1'9A73246*64**A**C***A*********A***A***S***A********
V*************************************	
YCTFMC==1FCTGN2010==1072************************************	D*****G****A****C*****C*****D****D****C*****C*****C******
DATE 05 APR 72 PAGE 39	TAD. 426249.2.100
0. 2010 0. 201 at 22.2	

12. AXIAL BLADE DESIGN PROGRAM

AXIAL BLADE DESIGN PROGRAM

1. INTRODUCTION

- a. A computer program has been developed to assist in defining the blade profiles for axial machines. Given basic blade data such as inlet and discharge angles, leading and trailing edge radii, aspect ratio, and thickness to chord ratio; a profile can be developed using this program which minimizes local fluid acceleration on the blade surface.
- b. Included is a listing of the program with a brief description of its application. A complete description of the analysis associated with this program appears in the NERVA Turbopump Design Report, N8300R:71-076.
- c. The program is complete and was used to develop the NERVA turbine blade profiles.
- d. This program is applicable as long as the turbine remains axial flow. $\dot{}$
 - e. No related activities.
 - f. This program was developed by K. G. Kirk.

2. CONCLUSIONS

a. Gross Conclusions

- (1) This program was used successfully to develop the blade profiles for the NERVA Turbine. The program also provides the data necessary for defining the blade profiles in a plane normal to a stacking line and the data used in velocity distribution calculations.
 - (2) The program is complete in its present form.

3. RECOMMENDATIONS

a. Achieving a satisfactory blade with this program requires an iterative process. A set of spline points are selected, the surface is spline fit and checked, spline points are adjusted as needed and the process is repeated until a satisfactory blade profile is obtained. With some programming effort this iterative process could be done within the program, resulting in considerable savings in time and effort.

b. The program can be used to supply digital data alone, or digital data and punched output which serves as input to a section property program, velocity distribution program, and blade stacking program. In addition, it is recommended that the program be used with the plot option if a plotter is available.

DATE 19 MAY 72 PAGE 1K1RK,427825.1,100 8 ELT CDIN1.1.720519, 31505 SUBROUTINE CDIN1 (LREC, TITLE, XC, YC) 000001 DIMENSION LREC(6), X(2), Y(2), TITLE(20), XC(1000,2), YC(1000,2) 000002 000003 10 FORMAT (4E20.9) 000004 20 FORMAT (20A4) 600005 30 FORMAT (15) 000006 LREC(J)=N 000007 READ (5:20) TITLE 800000 DO 100 J=1.2 READ (5,30) N READ (5,10) (XC(I,J),YC(I,J),I=1,N) 000009 000010 100 CONTINUE 000011 000012 RETURN 000013 ENU BLADE DESIGN

DATE 19 MAY 72 PAGE 72 1KIRK,427825,1,100 @ ELT CDOUT . 1 . 720519 . 31498 SUBROUTINE CDOUT (LREC.TITLE.XC.YC) 000001 DIMENSION LREC(6), XX(2), YY(2), TITLE(20), XC(1000,2), YC(1000,2) 000002 10 FORMAT (4E20.9) 000003 20 FORMAT (20A4) 000004 30 FORMAT (15) 000005 · WRITE (2,20) TITLE 000006 no 50 J=1.2 ้อนบอ**ว**า N=LREC(J) 800000 WRITE (2.30) N 000009 ICONT=0 000010 DO 50 I=1.N 000011 ICONT=ICONT+1 000012 X=XC(1+J) 000013 Y=YC(I,J) 000014, XX(ICOUT)=X 000015 YY(ICONT)=Y 000016 IF (ICONT-2) 35,40,40 000017 35 IF (I-H) 50,40,40 40 WRITE (2,10) (XX(K),YY(K),K=1,ICONT) 000018 000019 ICONT=0 000020 50 CONTINUE 000021 000022 RETURN END 000023

```
1KIRK,427825,1,100
                                                                                  DATE 19 MAY 72 PAGE 73
      @ ELT CPUOT, 1,720519, 31516
000001
                       SUBROUTINE CPLOT (ARGX ARGY IMARGI)
000002
                 C THE DARRAY A IST THE PATA ISTORAGE CONTAINING YES PROTICURIES PRACHIWITH A ...
                 C MAXIMUM OF 50 X4Y PAIRS. NP DEFINES NUMBER OF DATA PAIRS PER CURVE.
000003
000004
                      COMMON /SPLFIT/
                             ' G(100)+SB(100)+EM(50)+SLOPE(50)+CURV(50)+X(50)+Y(50)
000005
                        COMMON! /DATA/ A(2,50,50), NP(51)
000006
                        DIMENSION ARGX(1000.6), ARGY(1000.6), INARG(6)
000007
                        DIMENSION Z(1000) YINT(1000)
000008
                        DIMENSION XTITL(10), TITLES(10)
000009
                       DIMENSION AYLEN(5) AYMIN(5) AYMAX(5) NYSTRT(5) NYSCAL(5) NYSIZE(5)
000010
                    '""1, NYFRAC(5), YTITL(10,5)
000011
                 C THESE CELLS TO BE USED BY SPLINE CURVE FIT
000012
000013
                 C THE PLOT ROUTINE READS INPUT CARDS FOR PLOT SETUP AND CONTROL
000014 .
                      1 FORMAT (12:11)
000015
                       FORMAT (12, 3F9.0, 313, 12, 6A6, A4)
000016
                 C READ CARD 00
000017
                      3 READ (5,1) ID, NYAXIS
000018
000019
                        IF (ID.NE.0) GO TO 999
000020
                        IF (NYAXIS.GT.5) GO TO 999
                                                                                         000021
                 C READ CARD 01 FOR X-AXIS CONTROL
                       PEAD (5,2) ID, AXLEN, XMIN, XMAX, NXSTRT, NXSCAL, NXSIZE, NXFRAC
000022
000023
                       1 *(XTITL(J)* J=1.7)
                        IF (ID.NE.1) 60 TO 999
000024
                        IF (NXSIZE . EQ. 0) NXSIZE = 2
~000025
000026
                  C READ CARDS 02 FOR Y-AXIS CONTROL
000027
                        DO 10 I=1.NYAXIS
                        READ (5.2) ID.AYLEN(I).YMIN(I).YMAX(I).NYSTRT(I).NYSCAL(I)
ີ0ປປິລິຍົ
000029
                       1 ,NYSIZE(I), MYFRAC(I), (YTITL(J,I), J=1,7)
                        IF (ID.NE.2) GO TO 999
000030
                        IF (HYSIZE(I).EQ.0) HYSIZE(I) = 2
ÜUÚ031
000032
                     10 CONTINUE
                  C COMPUTE PRELIMINARY CONTROL FOR SETUP OF X AND Y AXIS
000033
                  C SET UP THE X-AXIS AND THE BASIC Y-AXIS
000034
000035
                        IF (NXSTRT.EQ.0)
                                               NXSTRT=50
                  C X-AXIS UP 1 INCH ON PLOT
000036
                        IF (NYSTRT(1) \cdot EQ \cdot O) NYSTRT(1) = 500
000037
                 C Y-AXIS STARTS 3 INCHES FROM MARGIN ON DEFAULT
000.038
                 C COMPUTE PRELIMINARY CONTROL FOR SETUP OF X AND Y AXIS
000039
                        XLABLD = (XMAX - XMIN) / AXLEN
000040
                        YLABLD = (YMAX(1) - YMIN(1)) / AYLEN(1)
000041
000042
                        NXLINE = NXSTRT - 25
000043
                        NYLINE = NYSTRT(1)
                        MAXX=IFIX(100.*AXLEN)+NYSTRT(1)
000044
                        MAXY=IFIX(100.*AYLEN(1))+NXSTRT
000045
                        CALL PLTSU (0,XMIN,YMIN(1),NYSTRT(1),NXSTRT,XLABLD,YLABLD,100,100
~~000046
                       1.NXFRAC.NYFRAC(1).NXLINE.NYLINE.MAXX.MAXY.NXSCAL.NYSCAL(1))
000047
000048
                       MXBEGN = MYSTRT(1) + (100 * IFIX(AXLEN)) \frac{7}{2} - 320
                        CALL PLTBC (XTITL: 40: MXBEGN: NXLINE-35: MXSIZE: 0)
000049
000050
                  C HORIZONTAL AXIS NOW LABELED
                        NYBEGH = MXSTRT + (100 * IFIX(AYLEN(1))) / 2 - 320
000051
ับบบ052
                        NXBEGN = NYLINE-60
000053
                        CALL PLTSC (YTITL(1,1),40,NXBEGN,NYBEGN,NYSIZE(1),1)
                  C BASIC Y AXIS NOW COMPLETED
000054
<u>"u0uu55</u>
                        MCODE = 1
000056
                        ZMAX = AYLEN(1)
```

```
DATE 19 MAY 72 PAGE
                  1KIRK, 427825, 1, 100
                       IF (NYAXIS.FQ.1) GO TO 21
000057
                 C SET UP SECONDARY Y AXIS
000058
                       DO 20 I=2,NYAXIS
000059
                       MAXY=IFIX(100.*AYLEN(I))+NXSTRT
000060
                       IF (AYLEN(I).GT.ZMAX) ZMAX = AYLEN(I)
000061
                       IF (NYSTRT(I).EQ.O) NYSTRT(I) = NYSTRT(I-1) - 100
000062
                        YLABLD = (YMAX(I) - YMIN(I)) / AYLEN(I)
000063
                       MYLINE = NYSTRT(I)
000054
                       CALL PLISU (1.XMIN.YMIN(I).NYSTRT(I).NXSTRT.XLABLD.YLABLD.100.100
000065
                       1.NXFRAC.NYFRAC(I).0.NYLINE.MAXX.MAXY.NXSCAL.NYSCAL(I))
000066
                       NXBEGN = NYLINE - 60
000067
                       MYBEGN = MXSTRT + (100 * IFIX(AYLEN(I))) / 2 - 320
000068
                        CALL PLTRC (YTITL(1,1),40,NXBEGN,NYBEGN,NYSIZE(1),1)
000069
                     20 NCODE = I
000070
                    21 CONTINUE
000071
                        MAXY = IFIX(100. * ZMAX) + NXSTRT
000072
                  C SET UP FOR TEST OF LAST POSITION OF THE PEN
000073
                        XCOD = 0.
000074 4
                        YCOD = 0.
000075
                        MARG = 0
000076
                     30 READ (5.31.END=201)
000077
                                    ID, NEILE, NAXIS, LEIT, LPRINT, LARGPL, NSYMBL, INTV, LINE
000078
                       1 ,XSTART, YSTART, (TITLES(K), K=1.7)
000079
                      FORMAT (212, 411, 213, 11, T21, 2F10.0, 6A6, A4)
000080
                        iF (ID.NE.3) GO TO 100
0900031
                        IF (NFILE.GT.50) GO TO 98
000082
                        IF (NAXIS.GT.NYAXIS) GO TO 98
000083
                        IF (LARGPL.GT.6) GO TO 98
000084
                                                NSYMBL=64
                        IF (NSYMBL.E0.0)
000085
                 C GO TO PLOT THE DATA GIVEN THROUGH THE ARGUMENT TO CPLOT
050086
                        N = NP(NFILE)
000037
                        TE (MAXIS.ED. NCODE) GO TO 40
โต้ดินเครื่อใ
                        I = HAXIS
000089
                        MCODE = MAXIS
000090
                        YLABLD = (YMAX(I) - YMIN(I)) / AYLEN(I)
000091
                        CALL PLTSU (1,XMIN,YMIN(I),NYSTRT(1),NYSTRT,XLABLD,YLABLD,100,100 .
065092
                       1.NXFRAC.HYFRAC(I).0.0.MAXX.MAXY.NXSCAL.NYSCAL(I))
000093
                     40 IF (LARGPL.NE.0) GO TO 90
000094
                        IF (LFIT.EQ.0) GO TO 80
000695
                        DO 41 J=1.N
000096
                        \chi(J) = \Lambda(1,J,NFILE)
000097
                        Y(J) = A(2,J,NFILE)
000098
000099
                     41 CONTINUE
                        CALL SPLINE (N.LPRINT)
000100
                        XMIND = .05 * XLABLD
000101
                        DELTAX = (X(N) - X(1)) / 999.
000102
                        IF (DELTAX.LT.XMIND) DELTAX = XMIND
000103
                        MAX = IFIX((X(N) - X(1)) / DELTAX) + 1
000104
                        M = MAX - 1
000105
                        7(1) = X(1)
000196
                        Z(MAX) = X(N)
000107
                        DO 42 L=2+M
000108
                      42 Z(L) = Z(L-1) + DELTAX
000109
                        MALL SPEINT (N.Z.YINT:MAX)
 009110
                        P1 .. (X(O) - Y(1)) **2 + (YCO) - YINT(1)) **2
 1000111
                        102 - (/COD - /(MAY)) **2 + (YCOD - YIHT (MAY)) **2
 June 1 12
                         II (RI.GI.R2) GO TO 43
 1000115
                         yCOD = Z\{ttAX\}
 000114
                         YCOD = YINT(MAX)
 000115
                         1_OC = 1
 000116
```

```
DATE 19 MAY 72 PAGE
                   1KIRK, 427825, 1, 100
                        INC = 4
000117
                        GO TO 44
000118
                     43 \times COD = Z(1)
000119
000120
                        YCOD = YINT(1)
                        LOC = MAX
000121
000122
                        INC = -4
                     44 CALL PLTPT (LINE, MAX, INC, INC, NSYMPL, INTV, Z(LOC), YINT(LOC))
000123
                        60 TO 30
000124
                  C PLOT THE DATA FROM RAW POINTS
000125
                     80 R1 = (XCOD - A(1,1,NFILE))**2 + (YCOD - A(2,1,NFILE))**2
000126
                        R2 = (XCOD - A(1,N,NFILE))**2 + (YCOD - A(2,N,NFILE))**2
000127
                        IF (R1.GT.R2) GO TO 81
000128
                        XCOD = A(1 \cdot N \cdot NFILE)
000129
้อย่อ130
                        YCOD = A(2,N,NFILE)
                        LOC = 1
000131
000132
                        INC = 8
                        GO TO 82
000133
                     81 \times COD = A(1.1.NFILE)
000134 .
                        YCOD = A(2,1,NFILE)
000135
                        LOC = N
000136
                        INC = -8
000137
                     82 CALL PLTPT (LINE, N, INC, INC, NSYMBL, INTV.
000138
                       1 A(1,LOC,NFILE),A(2,LOC,NFILE))
000139
                        GO TO 30
000140
                                                                                              . . .
                  C PLOT FROM THE ARGUMENT TO CPLOT
000141
                        FNTRY CPLOTI (ARGX, ARGY, INARG)
000142
                     90 K = LARGPL
000143
                        MARG = IMARG(K)
000144
                        IF (NARG.GT.1000) GO TO 98
โดยดูรูนุธ์
                         R1 = (XCOD - ARGX(1,K))**2 + (YCOD - ARGY(1,K))**2
000146
                        R2 = (XCOD - ARGX(NARG,K))**2 + (YCOD - ARGY(NARG,K))**2
000147
                        IF (R1.GT.R2) GO TO 91
000148
000149
                        XCOD = ARGX(NARG+K)
                        YCOD = ARGY(NARG,K)
000150
                        LOC = 1
[000151]
                        .INC = 4
000152
                        GO TO 92
000153
                      91 \times COD = ARGX(1.K)
000154
000155
                        YCOD = ARGY(1,K)
                         LOC = NARG
000156
000157
                         INC = -4
                     92 WRITE (6,1000) LINE, NARG, INC, INC, NSYMBL, INTV, (ARGX(IK, K), ARGY(IK, K
000158
                       1) , IK=1 , NARG)
000159
                                       ENTRY PLTPT'/615/(2E20.6))
                   1000 FORMAT ( 1
000160
                         CALL PLIPT (LINE, NARG, INC, INC, NSYMBL, INTV
000161
                        1, ARGX(LOC, K), ARGY(LOC, K))
000162
                         60 TO 30
000163
                     98 WRITE (6,99) NFILE, NAXIS, LARGPL, NARG
000164
                      99 FORMAT ( * CHECK ONE OF THE FOLLOWING INPUT ON 03 CARD. NFILE=' . IZ.
000165
                       1' NAXIS=',11,' LARGPL=',11,' NARG=',14)
000166
                         60 TO 30
000167
                  C PLOT THE TITLES FROM THE 04 AND 05 CAPDS
000168
                     100 NXBEGN = NYSTRT(1) + (100 * IFIX(AXLEN)) / 2 - 320
[000169]
                     101 IF ((ID.NE.4).AND.(ID.NE.5) ) GO TO 200
000170
                         IF (XSTART.NE.O.) NXBEGN = IFIX(XSTART)
000171
                         IF (YSTART.NE.O.) MAXY = IFIX(YSTART)
000172
                         IF (ID.E0.4) MAXY = MAXY - 31
000173
                         IF (ID.E0.5) MAXY = MAXY - 24
000174
                         ISIZE = 7 - ID
[000175]
                         CALL PLTBC (TITLES, 40, NXBEGN, MAXY, ISIZE, 0)
000176
```

DATE 19 MAY 72 PAGE 76 1KIRK, 427825, 1, 100 READ (5,102,END=201) 000177 1 ID.XSTART, YSTART, (TITLES(K), K=1.7) 000178 102 FORMAT (12: 18X: 2F10:0: 6A6: A4) 000179 GO TO 101 000180 200 IF (ID.EQ.88) GO TO 3 000181 / IF (ID.E0.77) RETURN 000182 201 CALL PLTFIN 000133 RETURN 000184 999 WRITE (6,998) ID 090185 998 FORMAT (' THE CARD WITH ID OF '.12. WAS ENCOUNTERED UNEXPECTEDLY.
1 10 OF 0.1 OR 2 WAS EXPECTED') 000186 ~00018**7** RETURN 600188 END 000189

	DO TOO SHISE=I'S		950000
37	CHORD=CHORD*SCA)		000022
	ST6R=ST6R*SCALE		4 90000
DEA.DEUTO.CHORD.STGR.DELX.SCALE.ORF.NBBI	138 (646) FIIRW		£50000
	WRITE (6,65)		_S20000
M.CP. AR. ONEGA. WIFL. 119.00.9211 . BETO . W . GAD. W.	WRITE (6,61) GA		190000
	WRITE (6,60)		050000
	SCALE=1.0	00E	_6+00000
	IE (SCVEE) 2001	_	840000
RD.STGR.DELX.SCALE.MBG1	ioH⊃.oTij∃d.A∃d∃a.	,	T40000
ONEGA, WIFL, TIP, PO, BEIL	MAD (05.20) GAM		9#0000
	WRITE (6,1020)		540000
	WEITE (6,1005)	•	440000
	BEAD (5.6) TITLE		<u> 5+00000</u>
IN ID IL	WRITE (6.1000)		S40000
500.70.00	; ((II)əAJƏİ) ƏL	87 ·	τ ή ο ο ο ο
	<pre>IF (IFLAG(10)) 3</pre>		_040000
·IV·IFLAG	DEVO (2°2)IW'ID		660000
(\(\sigma\) \(\sigma\)	FORMAT (S6X, INF		860000
	FORMAT (1X 20A4)	SOOT	_YE0000
* VS' VS' VS'29X', BT VJE BBOEIFE BBOEBWA\)	FORMAT (*1DATE :	0001	920000
2F10.2)	FORMAT (2F10.4+2	94	920000
	*DE@ * 1X1 DE@ (\)	τ	_#£0000 <u></u>
.9X.'8R'.KX''BETAI'.5X''BET10'\5X''1\0'.9X''1\0'.7X'	FORMAT (5X+1RI+	SL .	££0000
	FORMAT (12F10.6)	TL.	000035
	(/+X++X6++X++	Τ	_troopog
VOE COCRDINATES, SURFACE ':IL /6X.55('X'.9X.'Y'.9X)	FORMAT (44X 'BL)	07	020000
\$*#>\$F10*#\F9*3\F10*#\F10*2\10*]	FORMAT (F8.3-F12	99	620000
	(\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	S	_850000
*. 6X, 'NBL', 7X, 'NBRI', /IHX, 'LB/FI3', 5X, 'IN', 9X', 'IN'	*SCVIE * * 2X * * OBE *	τ	750000
VC+>PX>+DEVIOF+>#X>+CHOKD++PX++PX+PZEK++PX+DEFX++PX+	13039* (X&) TAM903	59	00000
1*3.5F10.1*2F10.2*F10.1*E10.4*F10.1\)	LITA. C. 69) TAMHOH	19	_520000
(/·NI·*X	<8 + * N.I * + X.Q + * N.I * +	17	00002#
EQ. • CX. • ELYZEC. • CX. • IA. • #X. • ELYZEC. / I#X. • FB/EL2. • 2X	.7X,*DEG**XY	ξ	0000032
=L\DEC-6'+'\tX\+'BbW+'CX\+'FB\Z\C+\+\tX\+\DEC-B\+'CX\+\BZ\V\	3* • XS • • 9-81/UT8*	2	00005
** #X* * BETAO * 6X* * 4X* * PROJUS* * 4X* * WZ* / LOX*	*IATBU**XY**ITG*	Ţ	120000
V4 - 6X* . CD . * 8X* . Bx * 2X* . GEED . * ZX* . M . * 8X* . LII. * 2X*	YAAP (4X • . • GAN	0 à	020000
	_(0•0138) TAM90∃	011	610000
	FORMAT (IS.4F10.		. 810000
3F10.0/3F10.0.215}	F08MAT (8F10.0A	. 50	71000
	FORMAT (20A4)		- at0000
	FORMAT (3A2.4X.1		910000
(P) • (DVIV(S8) • MS)			, 410000
A (24) +PO) • (DATA(25) • W • (5S) ATA(3) • (04) • (10) •	EGALAVERICE (DAT		_610000
(DAIA(21), HET12), (DAIA(22), BET02), (DAIA(23), DUMY2)) • (SOH• (OS) ATAG)	ς	Siouuo
(SIN(4C1)*(DXTA(18)*(DXTA(18)*(DXTA(18)*(TI)*(TI)*(TI)*(TI)*(TI)*(TI)*(TI)*(TI	(IIII84(8I)ATAO)	Ħ	T10000
(DATA(12),DENTO),(DATA(14),RII),(DATA(15),ROI),	(ARGEA) (SI) ATAG)	2	000000
98E10) (DVIV (10) CHOBD) ((I/IV (11) 21eK) •	4(9)ATAC)+(ITBR		600000
·WIEL) • (DA A (6) • OMEGA) • (DATA(7) • OME(8) •	• (Z) ATAG) • (910Hg	ī	800000
(41) • (MYA (2) • (AT (2) • (AT (4) • (AT (4) • (MYA) • (MYA (4) •	FOULVALENCE (DAT		
TITLE(SO).DAIA(SAS).YB(SASS).NBL.NBBI	COMMON IM, ID, IY,	•	900000
	(OS) A	. T	900000
@(100) *28 (100) *EW(20) *2F0bE(20) *CNBA(20) *X(20) *	COMMON YSPLFITY	//	
•1E-V@(1#)	DIMENSION NUM(S)	/	\$00000
	INTEGER SURF		S00000
(NUW-DELX-IFLAG)	TU9NI ANITUOABUZ	/	T00000
	5	/ .	
	00516 4618	ELT INPUT:1,720	C)
	•		
		\$11.m\$1.00	
DYLE 16 WAL 15 DRGE 11	+427825 .1 ,100	TKIBK	

		12102 607025 1 100	DATE 19 MAY 72 PAGE 78
		IKIRK,427825,1,100	DAIL 19 MAI IS FACE IN
0.00	0057	READ (5,30) NUM(SURF) RI RO BETAL BETAO	
	0058	IF (SURF-1) 80.80.90	
	0059	80 RI1=RI*SCALE / R01=R0*SCALE	
	0060	/ RETIT=RETAI	
	J061 J062	BETO1=BETAO	
	0063	60 TO 95	
	0064	90 RI2=RI*SCALE	
	J065	RO2=RO*SCALE	
	0066	neti2=BetAI	
	006 7 0068	BET02=BETA0 95 PM1=NUM(SURF)-1	
	0069	READ (5:40) (X(I):Y(I):I=2:NM1)	
	0070	00 150 I=2.NM1	
	0071	XB(SURF,I)=X(I)*SCALE	
	U0 72	150 YB(SURF,I)=Y(I)*SCALE	
	0073	WRITE (6,70) SURF	
	0074, 0075	WRITE (6,71) (X(I), Y(I), I=2,NM1) WRITE (6,75)	
	0075	100 WRITE (6,76) RI,RO,BETAI,BETAO	
	0077	200 RETURN	
	U078	END	
	•		
	· · · · · · · · · · · · · · · · · · ·		
•			
	<u></u>		

,

```
DATE 19 MAY 72 PAGE 79
                   1KIRK . 427825 . 1 . 100
      @ ELT MAIN, 1, 720519, 31485
                        INTEGER SURF
000001
                        DIMENSION Z(500 ). LREC(6). NUM(2). DATA(28): XB(2.25). YB(2.25).
000002
                       11FLAG(14).XC(1000.2).YC(1000.2).SLO(1000.2).RCURVE(1000.2).
000003
                       2XSH(1000,2),YSH(1000,2),XST(1000,2),YST(1000,2),SLENTH(2),
600004
                       3ARGX (6000) + ARGY (6000)
000005
                        COMMON /SPLFIT/ G(100).SB(100).EM(50).SLOPE(50).CURV(50).X(50).
000006
                       1Y(50)
000007
                        COMMON IM, ID, IY, TITLE (20), DATA, XB, YB, NSL, MBRI
600008
                        EQUIVALENCE (DATA(1), GAM), (DATA(2), AR), (DATA(3), T1P), (DATA(4),
000009
                       IRHOIP), (DATA(5), WTFL), (DATA(6), OMFGA), (DATA(7), ORF), (DATA(8),
้องขอร์อ
                       2HETI ), (DATA(9), BETO ), (DATA(10), CHORD), (DATA(11), STGR),
000011
                        3(DATA(12), REDFA), (DATA(13), DENTO), (DATA(14), RI1), (DATA(15), RO1),
030012
                       4(DATA(16), BET11), (DATA(17), BET01), (DATA(18), DUMY1), (DATA(19), RI2), &
000013
                       5(DATA(20), RO2), (DATA(21), BETI2), (DATA(22), BETO2), (DATA(23), DUMY2)
030014
                         EQUIVALENCE (DATA(24), PO), (DATA(25), WX), (DATA(26),
000015
                        1RAD) . (DATA(27) . CP) . (DATA(28) . W2)
000016
                         EQUIVALENCE (ARGX(1),XC(1,1),XST(1,1))
009017
                         EGUIVALENCE (ARGX(2001), XSH(1,1))
600018
                        EQUIVALENCE (ARGY(1), YC(1,1), YST(1,1))
000019
                         FQUIVALENCE (ARGY(2001), YSH(1,1))
000080
                         EQUIVALENCE [(ARGY(4001), RCURVE(1,1))
000021
                      10 FORMAT (//' SURFACE LENGTH=' F10.3)
0000022
                         CALL ERRSET(259,300,-1,0,0,0)
000023
                         TSTK#0
000024
                      50 CALL INPUT (NUM, DELX, IFLAG)
โยอบ025
000026
                         IF (IFLAG(10)) 60,65,60
                      60 CALL CDIN1 (LREC.TITLE.XC.YC)
000027
                         60 TO 659
້າວນນູ້ປ28 ື
                      65 IF (IFLAG(11)) 70,75,70
000029
                      70 CALL CDING (LREC, TITLE, XC, YC)
000030
T00u031
                         60 TO 651
                      75 DUMY1=0.0
000032
                         DUMY2=0.0
000033
                         RHOIP=0.0
T000034
000035
                         JFLAG=0
                         KFLAG=0
060036
                         N1=NUM(1)
~000037
                         N2=NUM(2)
.000038
                         BETAI=BETI1/57.295779
000039
                         CALL XYI (BETAI, RII, 1., XB(1,1), YB(1,1), DYOX)
000040
                         BETAI=BETI2/57.295779
000041
                         CALL XYI (BETAI, RI2, -1., XB(2,1), YB(2,1), DYDX) .
000042
                         BETA0=BET01/57.295779
000043
                         CALL XYO (BETAO, RO1, CHORD, STGR, 1., XB(1, N1), YB(1, N1), DYDX)
0.00044
                         BETA0=BET02/57.295779
000045
                         CALL XYO (BETAO, RO2, CHORD, STGR, -1., XB(2, N2), YB(2, N2), DYDX)
000046
                         DO 650 SURF=1.2
000047
000048
                         LFLAG=0
                         NM1=NUM(SURF)-1
000049
                         M=NUM(SURF)
000050
                         IF (SURF-1) 80,80,90
000051
                      80 L=1
000052
000053
                         RI=RI1
                         R0=R01
000054
                         BETAI=BETII
000055
000056
                         BETAO=BETO1
```

		1KIRK,427825,1,100	DATE 19 MAY 72 PAGE 80
_	000057	60 TO 95	7.7
	000058	90 L=2	
	000059	RI=RI2	tanan kacamatan da kacamatan da kacamatan da kacamatan da kacamatan da kacamatan da kacamatan da kacamatan da k
	000060	/ R0=R02	
	000061	BETAI=BETI2	
	000062	BETAGEBETO2	
_	000063	/ 95 BETAI=BETAI/57.295779	
	000064	PETAO=BETAO/57.295779 SLOPI=TAN(BETAI)	
	000065	SLOPO=TANGETAN)	
	000066	96 IF (L-1) 110,100,110	
	000057	100 SIGN=1.	
	000068	60 TO 150	
	000069 .	110 SIGH=-1.	
	030070	150 DO 160 I=1+N	
	000071	X(I)=X9(SURF,I)	
	009072	160 Y(1)=YB(SURF,I)	
	000075	SLENTH(SURF)=RI*(1.570795-SIGN*BETAI)	. The state of th
	000074,	IF (SURF-1) 170,170,410	
	099076	170 DTHET=0.001*SIGN/RI	Time to the control of the control o
	000077	THETA=3.14159*SIGN/2.	
	000078	5=0.0	
===	000079	T=0.0	
	030079	xC(1,SURF)=S	
	000000	YC(1.SURF)=T	
	030081 030082	RCURVE(1,SURF)=RI	
	000062	SLO(1, SURF)=1.0E50*SIGN	
	00008 3	Ţ=1	
~	000085	200 I=I+1	•
	000086	THETA=THETA-DTHET	
	050087	CALL XYI (THETA:RI:SIGN:S:T:DYDX)	
-	680069	IF (JFLAG) 210,210,240	
	600089	210 IF (5-XB(2,1)) 240,240,220	
	0.0090	220_JFLAG=1	
_	000091	S=XB(2,1)	
	030092	T=SQRT(RI**2-A8S(S-RI)**2)	
	600093	240 IF(S-X(1)) 250,300,300	
-	000094	250 XC(1, SURF)=S	
	600095	YC(I,SURF)=T	The second secon
	£900A9	RCURVE(I, SURE)=RI	
-	000097	SLO(I.SURF)=DYDX	
	000098	J=I	
	000099	eo 10 sou	1 6
	000100	300 I=1	
	000101	Z(1)=X(1)	
	000102	IF (JFLAG) 360.360.350	
	000103	350 I=I+1	
	000104	Z(I)=Z(I-1)+OELX IF (Z(I)-XB(1.N1)) 370.375.375	
	000105	370 IF (Z(1)-XB(1,N1)) 370,373,373 370 IF (Z(1)-XB(2,N2)) 350,380,380	
	000106	370 IF (Z(I)+XB(Z/NZI) 350/380/380	
	000107	50 TO 490	
	000108	380 KFLAG=1	
	000109	Z(I)=XB(2,N2)	
	000110	THETA=-BET02/57.295779	
	000111	DTHET=0.001*SIGN/RO	
	000112	385 I=I+1	
	000113	THETA=THETA-DTHET	
	000114	CALL XYO (THETA, RO, CHOPD, STGR, SIGN, S.T.	(אַחָאָרָס,
	000115	IF (S-XB(1+N1)) 390+375+375	
		11 /2 ////// 0/4/0/2/0/	

.

		DATE 19 MAY 72 PAGE 81
	1K1RK,427825,1,100	DATE 19 MAY 72 PAGE 81
000117	390 Z(I)=S .	
000118	GO TO 385	
000119	360 I=I+1	
000120	/ CALL XYI (THETA.RI.SIGN.S.T.DYDX)	
000121	/ IF (S-XB(2,1)) 361,365,365	
000122	361 Z(I)=S	
000123	/ THETA=THETA-DTHET	
0.0124	GO TO 360	
000125	365 Z(I)=X8(2,1)	
000126	GO TO 350	
000127	410 IRM1=0	
000128	I=0	
000129 .	412 IRM1=IRM1+1	
000130	S=XC(IRM1.1)	
000131	7 = Y C (IRM1 + 1)	
000132	DYDX=SLO(IRM1.1)	
000133	IF (UFLAG) 415,415,430	
000134,	415 IF (S-XB(1,1)) 420,420,430	. · · · · · · · · · · · · · · · · · · ·
000135	420 T=-T	
000136	XUYG-=XUYQ	$x_i \in [x_i, x_i] \cap \{x_i \in [x_i, x_i] \in [x_i, x_i] \in [x_i, x_i] \cap \{x_i \in [x_i, x_i] \in [x_i, x_i] \in [x_i, x_i] \}$
000137	425 XC(IRM1,SURF)=S	
000138 \	YC(IRM1,SURF)=T	
000139	RCURVE(IRM1.SURF)=RI	
000140	SLO(IRM1.SURF)=DYDX	
000141	J=IRM1	
J00142	GO TO 412	
000142	430 IF (S-X8(2,1)) 440,450,460	
000144	440 T=-SORT(RI**2-ABS(S-RI)**2)	
000144	IF (T) 442,441,442	 -
000145	441 DYDX=1.0E50*SIGN	
000143	GO TO 425	
000147	442 DYDX=(RI-S)/T	
000149	60 TO 425	
000150	450 I=I+1	
000151	Z(I)=S	
000152	60 TO 412	
000153	460 IF (S-XB(2,N2)) 450,450,490	
000154	490 CALL SPLN2 (N.SURF.SLOPI.SLOPO)	
000155	ANT SPINT (N.SHRF.Z.J.T.L.LREC.XC.YC.	SLO.RCURVE.SLENTH)
000156	SLENTH(SURF)=SLENTH(SURF)+R0*(1.570795	5+SIGH*BETAO)
000157	WRITE (6,10) SLENTH(SURF)	
000158	THETA=BETAO	
000159	DTHET=0.001*SIGN/RO	
000160	M=0	
000161	500 J=J+1	
000162	THETA=THETA-DTHET	
000163	IF (SIGN*THETA+3.14159/2.) 550,600,600	
000164	550 THETA=-SIGN*3.14159/2.	
000165	M=1	
	600 CALL XYO (THETA, RO, CHORD, STGR, SIGN, S, T	OYDX)
000167	IF (LFLAG) 601,601,624	
000168	601 JF (SURF-1) 602,602,605	
000169	602 IF (KFLAG) 603,603,624	
(00170	603 IF (S-XB(2+N2)) 624,624,604	· Control of the cont
000171	604 THETA=-BET02/57.295779	
000172	LFLAG=1	
000173	GO TO. 600	
	605 IF (KFLAG) 624,624,606	
000174		
000174 000175	606 IF (S-XB(1,N1)) 624.624.607	

		•
	1KIRK,427825,1,100	DATE 19 MAY 72 PAGE 82
	A FI And	
000177	LFLAG=1	
000178	GO TO 600	
000179	.624 XC(J.SURF)=S	
000180	/ YC(J,SURF)=T	
000181	/ RCURVE(J.SURF)=RO	
900182	/ SLO(J.SURF)=DYDX	·
000183	/ IF (M) 625.500.625	·
000184	/ 625 LREC(L)=J	
000185	LREC(L+4)=J	
000186	DO 640 LOC=1/J	
000187	LOCA=LOC+1000*(SURF+3)	
000168	640 ARGX(LOCA)=XC(LOC.SURF)	
000189	650 CONTINUE	
000190	IF (IFLAG(9)) 654,658,654	
000190	654 CALL CDOUT (LPEC.TITLE.XC.YC)	
000191	658 IF (IFLAG(8)) 651,659,651	
	651 IF (ISTK) 653,652,653	1
000193		· ·
000194.	652 ÎSTK=1	THE THE TOUTY.
000195	CALL STAK (1:RAD.LREC.XHT.YHT.YCENT.TITL	PER THIS FORTILE
000196	1XTRAM, YTRAM, XC, YC, XSH, YSH, XST, YST)	
000197	GO TO 50	1
000198	653 CALL STAK(2.PAD.LREC.XHT,YHT,YCENT.TITL	realwarnata
000199	1xTRAN, YTRAN, XC, YC, XSH, YSH, XST, YST)	
000200	659 IF (IFLAG(5)) 660,670,660	
000201	660 IF (IFLAG(6)) 661,665,661	
690202	661 PITCH=2.*3.14159*RAD/NBL	
000203	CALL OFSET (LREC.PITCH.XC.YC.ARGX.ARGY)	
000204	665 CALL CPLOT (ARGX: ARGY: LREC)	
000205	670 IF (IFLAG(2)) 730,760,730	•
000206	730 CALL VELIN(NUM)	
000207	760 IF(IFLAG(7)) 761,765,761	
C 30208	701 CALL SECIN(LREC(1), N1, N2, IM, ID, IY, TITLE	F,XR,DELX,XC,YC)
000209	765 IF (IFLAG(1)) 50,800,50	
000210	800 STOP	
000210	ENU	7
000511		
		•
		- 1
		<u> </u>

								·. ·		
	•									
						. *				
			• • •	,	•					
<u> </u>				•			,			
							,	· · · · · · · · · · · · · · · · · · ·		-
				<u> </u>						
		•	• • • • •		 		·			*.
	<u>i</u>		,					<u> </u>		
					· · · · · · · · · · · · · · · · · · ·					
					 	12.6.45	1.0			
			•		, · · · · · · · · · · · · · · · · · · ·	• 34V) <u>,314 (111) (15)</u> 4	END 1 : 1 ((1 (0)) SKINI <u>(</u>	<u> </u>	200000 000000 000000 000000
							1 1	1205194 111 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		<u>סססמסס</u> ט ברו
		£83	19 may 72 page	3140	 			(18K+427825+)		
			!			1				,

W. Chim Hear Corn CANDATA I MITTAL THE LITTLE STATE OF THE CONTROL OF THE Carrier Factor of Alberton 4.2 (4.1 P.C.) 17.2 (2.1 P. 14.1 P. 14.1 P. 14.1 LOUR CONTRACTOR OF SUPERIOR CONTRACTOR market for the area of the graph of the contract of CONTRACTOR THE CONTRACTOR OF THE SHEET OF THE (15A * 15A * 165A * 16 * 1 De * 2 de la la ferial de la יאור בוא נויהשויות כיאוויאוויאכניוניודו ביואיוםיואי A SAME AND A SAME AS A SAME 0 THE END COURT (FIRE ! ITTEL ACTAC) TIOOOO RETURN (1997) Composition 010000 600000 700 VEGA(F)=AC(I'1)+bIICH C (1011, 10(p +1) DX=(7) X98A 111,1 800000 (x+1000*(n+n)(21001+1=7) 200000 DO TOO I=1'N' ! 900000 C 900000 THEC(0+S)=THEC(1) (い) N=LREC(U) 500000 DO 100 7=1.8-01.09 DIMENZION THEC(P) .XC(1000.5) . LC(1000.5) . PREX(6000) . PREY(6000) 000000 C TG0000 'SUBROUTINE HOFSET(LREC.PITCH.XC.YC.ARGX.ARGY) 1 . (600) , 11 1 / 1 1. 1.11 50 (1805 11) 28 1/3" " 6.00 D ELT 0FSET.1.720519*.31492 1.00 TKIEK + 45762511-100 UVILE TO WAX IS GOOR BY

```
DATE 19 MAY 72 PAGE 85
                  1KIRK, 427825, 1, 100
      Q ELT PLTSU:1:720519, 31512
                       SUBROUTINE PLTSU (MOVEON, XCRIG, YORIG, HXPLOT, NYPLOT, XLABLD,
000001
                      1 YLABLD. NXLAB, NYLAB, NXFRAC, NYFRAC, NXLINE, NYLINE,
000002
                      2 MAXX, MAXY, NXSCAL, NYSCAL)
000003
                       COMMON /PLOTCM/ IPLOTF, NPLOTS
000004
                       DIMENSION IBUF(1000)
000005
000006
                                           60 TO 10
                       IF(IPLOTF .EO. 1)
000007
                       CALL PLOTS (IBUF, 1000, 9)
800000
000009
                        CONVERT OFF-SET ORIGIN TO INCHES.
000010
000011
000012
                       IPLOTE = 1
000013
                       MPLOTS = 0
000014
                        XCONST = 0.
000015
                        YORI=0.
000016
                        SUMY=0.0
                        GO TO 15
000017
                       XLEN = MAXLEN
                 C10
000018
                        CALL PLOT (XLEN:0:1998)
000019
                       CONTINUE
000020
                        IF (MOVEON .EO. 1)
                                               60 TO 15
000021
້ປິບບຽ22
                        XCONST=FLOAT (MAXLEN)
                        YCOHST=YORI
000023
                    15 SCALEY = 1.
000024
                                               SCALEY = 10.**NYSCAL
                        IF (NYSCAL .NE. 0)
000025
                        YORIGN = YORIG*SCALEY
000026
                        YORI=FLOAT (NYPLOT)/100.
000027
                        DYL = FLOAT (NYLAB )/100.
000028
                        DELTAY = YEARLD/DYL*SCALEY
000029
                        IF (NXLINE.E0.0) 60 TO 105
000030
000031
                        NPLOTS = NPLOTS+1
000032
                        SCALEX = 1.
                                               SCALEX = 10.**NXSCAL
                        IF (MIXSCAL .NE. 0)
000033
                        XORIGH = XORIG*SCALEX
000034
                        XORI = FLOAT(NXPLOT)/100.
000035
                        DXL = FLOAT(NXLAB )/100.
000036
                        DELTAX = XLABLD/DXL*SCALEX
000037
                        MAXLEN=(MAXX-NXPLOT)/100+3
000038
000039
                        SET-UP NEW LOGICAL ORIGIN.
000040
000041
                        XMEW=XORI+XCONST
000042
                        YNEW=YORI-YCONST
"000043"
                        SUNY#SUMY#YNEW
000044
                        CALL PLOT (XNEW, YNEW, -3)
000045
000046
000047
                        CONVERT LENGTH OF X-AXIS TO INCHES.
000048
~000049°
                        ITICK = LEN/NXLAB + 1
000050
                        XLEN = FLOAT(TTICK-1)*DXL
000051
                        XL = XLEN + DXL
000052
                        XV = FLOAT(ITICK) *XLABLD*SCALEX*XORIGN
000053
                        XLIMIT=XV
000054
                        IF (MXLINE . EQ. 0) GO TO 105
000055
000056
                        HEIGHT=0.14
```

```
DATE 19 MAY 72 PAGE 86
                  1KIRK . 427825 . 1 . 100
000057
000058
000059
                       CALL PLOT (0.,0.,3)
000060
                       CALL PLOT (XLEN, 0., 2)
000061
000062
                       DRAW TICK MARKS AND LABELS.
000063
000064
000065
000056
000067
000068
                       DO 100 I=1.ITICK
000069
000070
                        XL = XL - DXL
                        CALL PLOT (XL+0.+3)
000071
                        CALL PLOT(XL,-0.14,2)
000072
                        XV = XV-XLABLD*SCALEX
000073
                        CALL NUMBER (XL, -. 35, HEIGHT, XV, 0., NXFRAC)
000074
000075
                   100 CONTINUE
000076
                       DRAW Y-AXIS.
000077
000078
                   105 YLEN=MAXY
000079
                        YLEN=YLEN-YORI*100.
000080
                        ITICK = IFIX(YLEN)/NYLAB + 1
900081
                        YLEN = FLOAT(ITICK-1)*DYL
000082
                        YL = YLEN+DYL
0.000033
                        YV = FLOAT(ITICK) *YLABLD*SCALEY+YORIGN
000084
                        YLIMIT=YV
000085
                        IF (NYLINE.EQ.O) RETURN
000086
                        HEIGHT=0.14
000087
                        OFFSET=FLOAT (NXPLOT/100) -XORI
000088
                        XO=OFFSET
000089
                        CALL PLOT (XO,0.,3)
000090
                        CALL PLOT (XO, YLEN, 2)
[000091]
                        DO 110 I=1.ITICK
000092
000093
                        YL = YL - DYL
000094
                        X0=OFFSET
                        CALL PLOT(XO,YL,3)
000095
                        XO=OFFSET-0.14
000096
                        CALL PLOT (XO,YL,2)
~000097
                        YV = YV-YLABLD*SCALEY
000098
                        XO=OFFSET-0.25
000099
                        CALL NUMBER (XO, YL. HEIGHT, YV. 90., NYFRAC)
000100
                   110 CONTINUE
000101
000102
                        RETURN
000103
                        ENTRY PLTBC (BCI:NUMBCI:NXBEGN:NYPEGN:ISIZE:IVERT)
000104
000105
                        CONVERT TO INCHES.
000106
000107
                        XPAGE = FLOAT(NXBEGN)/100.-XORI
000108
                        YPAGE . = FLOAT (NYBEGN)/100 -- YORI
000109
                        MCHAR = NUMBCI
000110
000111
                        ANGLE = 0.
                        IF (IVERT .EQ. 1)
                                                ANGLE = 90.
000112
                        HEIGHT = FLOAT(ISIZE)*0.07
000113
                        CALL SYMBOL (XPAGE, YPAGE, HEIGHT, BCI, ANGLE, NCHAR)
000114
                        RETURN
000115
000116
```

```
DATE 19 MAY 72 PAGE 87
                  1KIRK,427825,1,100
                       ENTRY PLTPT (IPLOT NUMPT , INCX , INCY , ICODE , INCSYM , X , Y )
000117
000118
                       DIMENSION XARRAY(102), YARRAY(102), X(1), Y(1)
000119
000120
                       INTER = ICODE
000121
                       LINTYP = INCSYM
000122
                                               LINTYP = - LINTYP
                       IF(IPLOT .EO. 1)
000123
                       TCOUNT = NUMPT
000124
                        IX = INCX/4
000125
                       IY = INCY/4
090126
                       II = 1
000127
                        1 = لل
000128
                       60 TO 190
000129
                    180 JJ=JJ+1
000130
                        000131
                        ICOUNT=ICOUNT-1
000132
                        IF (ICOUNT.LT.1) RETURN
000133
                    190 XARRAY(1)=X(II)*SCALEX
000134
                        YARRAY(1)=Y(JJ)*SCALEY
000135
                       IF ((XARRAY(1).LT.XORIGN) .OR. (XARRAY(1).GT.XLIMIT) .OR.
000136
                      1(YARRAY(1).LT.YORIGN) .OR. (YARRAY(1).GT.YLIMIT)) GO TO 180
000137
000138
                    200 I=1
                    210 I=I+1
~vv0139
                    215 1I=II+IX
                                                                                         000140
                        JJ=JJ+IY
000141
                        ICOUNT=ICOUNT-1
000142
                        TE (TCOUNT.LE.O) GO TO 220
000143
                        XARRAY(I)=X(II)*SCALEX
000144
                        YARRAY(I)=Y(JJ)*SCALEY
TU00145
                        IF ((XARRAY(I).LT.XORIGN) .OR. (XARRAY(I).GT.XLIMIT) .OR.
000146
                       1(YARRAY(I).LT.YORIGH) .OR. (YARRAY(I).GT.YLIMIT)) GO TO 215
000147
                        NPIS=I
000148
                        IF (I.GE.100) GO TO 230
000149
                        GO TO 210
000150
                    220 IF (I.LE.2) RETURN
000151
                    230 XARRAY (NPTS+1)=XORIGN
000152
                        XARRAY(NPTS+2) = DELTAX
000153
                        YARRAY (NPTS+1) = YORIGN
000154
                        YARRAY(NPTS+2) = DELTAY
000155
                         CALL LINE (XARRAY, YARRAY, NPTS, 1, LINTYP, INTEQ)
000156
                        XARRAY(1) = XARRAY(100)
~000157
                        YARRAY(1) = YARRAY(100)
 000158
                                                GO TO 200
                        ·IF(ICOUNT .GT. 0)
000159
                        RETURN
000160
 200161
                        ENTRY PLTNU (XLOC.NUMDEC.NXLOC.NYLOC.ISIZE.IVERT)
 000162
 000163
                        XORR = FLOAT (NXLOC)/100. - XORI
 000164
                        YORR = FLOAT (NYLOC)/100. - YORI
 000165
                        HEIGHT = FLOAT (ISIZE) * . 14
 000166
                        ANGLE = 0.
 000167
                                                ANGLE = 90.
                        IF(IVERT .GT. 0)
 000168
                        CALL NUMBER (XORR, YORR, HEIGHT, XLOC, ANGLE, NUMBEC)
 000169
000170
 000171
                        ENTRY PLTFIN
 000172
 000173
                        XLEN = MAXLEN
 000174
                         CALL PLOT (XLEN.-SUMY.999)
 000175
                         IPLOTF=0
 000176
```

DATE 19 MAY 72 PAGE 88 1KIRK,427825,1,100 RETURN

6000 FORMAT ('1 ENTRY PLTSU, PLOT NO.'.13/ ' Y-ORIG DIST = ', F10.6/

1 ' Y-ORIG DIST = ', F10.6 / ' PLOT SIZE = ', F10.4, ' INCHES'/

2 ' TICK MARK INCR. = ', F10.6, ' INCHES'/ ' 1ST TICK MARK AT : '/

3 ' X = ', F10.6, ' Y = ', F10.6 /

4 ' NO. OF TICK MARKS ON X-AXIS = ', I6)

```
DATE 19 MAY 72 PAGE
                  1KIRK, 427825, 1, 100
      D FLT SECIN: 1,720519, 31504
                        SUBROUTINE SECIN (N.N1.N2.IM.ID.IY.TITLE.XB.DELX.XC.YC)
000001
                        DIMENSION TITLE(20), XB(2,25), XC(1000,2), YC(1000,2)
000002
                      5 FORMAT( 1DATE 1.A2.1-1.A2.1-1.A2.36X, BLADE PROFILE PROGRAM1/)
000003
                    10 FORMAT(41X, SECTION PROPERTIES PROGRAM INPUT DATA 1/)
000004
                    15 FORMAT( * X COORDINATES OF UPPER AND LOWER SURFACES ARE NOT THE SA
000005
                       1ME'/10X, 'XU=', E15.8, 'XL=', E15.8, 'YU=', E15.8, 'YL=', E15.8)
000006
                    20 FORMAT(15,5X,3F10.6)
000007
000008
                     6 FORMAT (20A4)
                    24 FORMAT(25X, 'YU', 18X, 'YL', 18X, 'XU'/)
000009
006010
                    25 FORMAT(10X.3F20.7)
                    30 FORMAT ( MORE THAN 49 POINTS!)
000011
                        K=1
000012
                        WRITE (6,5) IM, ID, IY
000013
                        WRITE (6,10)
000014.
                        WRITE(6,6) TITLE
000015
                        WRITE (2.6) TITLE
000016
                        DX=5.*DELX
000017
                        0=ل
000018
                        DO 200 I=1.N
000019
                        XU=XC(I,1)
000020
                        YU=YC(I,1)
000021
                        XL=XC(1,2)
[J00022]
                        YL=YC(I,2)
000023
                        IF (ABS(XU-XL)-0.0000001) 60.50.50
000024
                     50 WRITE (6,15) XU, XL, YU, YL
~000025
000026
                        GO TO 300
                     60 IF(I-1)65,65,70
000027
                     65 WRITE (6,24)
~00u028
000029
                        60 TO 190
                     70 IF(I-N)80,190,190
000030
                     80 IF (XOLD-X8(1,1))100,100,90
000031
                     90 IF(XOLD-XB(2,1))100,100,110
000032
                    100 IF(XU=(XOLD+DELX))200:190:190
000033
                    110 IF (XU-XB(1,N1))120,120,100
000034
                    120 IF(XU-X3(2.N2))130.130.100
000035
                    130 IF(XU-(XOLD+DX))200,190,190
000036
                    190 XOLD=XU
000037
                        WRITE(2,20)K,YU,YL,XU
000038
                        WRITE (6,25) YU, YL, XU
000039
                        J=J+1
000040
                        IF(J-49)200,200,250
000041
                    200 CONTINUE
000042
000043
                        GO TO 300
000044
                    250 WRITE(6,30)
000045
                    300 RETURN
                        ENU
000046
```

```
DATE 19 MAY 72 PAGE 90
                  1KIRK, 427825, 1, 100
      D ELT SPLINE, 1, 720519, 31507
                       SUBROUTINE SPLINE (N. SRW)
000001
000002
                       INTEGER SRW
000003
                    SPLINE CALCULATES FIRST AND SECOND DERIVATIVES AT SPLINE POINTS
                                                                                           3KIRK917
000004
                    END CONDITION-SECOND DERIVATIVES ARE THE SAME AT END POINT AND
                                                                                           3KIPK918
000005
                    ADJACENT POINT
000006
000007
                       COMMON /SPLEIT/
8000008
                             G(100), SB(100), EM(50), SLOPE(50), CURV(50), X(50), Y(50)
000009
                       SB(1)=-1.0
000010
                       G(1)=0.
000011
                       NO=N-1
000012
                       IF (110-2) 20,7,7
000013
                     7 00101=2:110
000014
                       A = (X(I) - X(I-1))/6.
000015
                       C = (X(I+1)-X(I))/6.
000010
                       V=2. *(A+C)-A*SB(I-1)
000017
                       58(I)=C/W
000018
                       F=(Y(I+1)-Y(I))/(X(I+1)-X(I))-(Y(I)-Y(I-1))/(X(I)-X(I-1))
                                                                                           3K
000019
000020
                    10 G(I) = (F - A * G(I - 1)) / W
                                                                                         20 EM(H)=G(H-1)/(1. +5B(N-1))
000021
600022
                       D030I=2.N
                       K=N+1-I
000023
                    30 EM(K)=G(K)-SB(K)*EM(K+1)_
000024
                       SLOPE(1)=(X(1)-X(2))/6. *(2. *EM(1)+EM(2))+(Y(2)-Y(1))/(X(2)-X(13KIRK940
000025
                      1))
000026
                       D0401=2.N
000027
                     40 SLOPE(I)=(X(I)-X(I-1))/6. *(2. *EM(I)+EM(I-1))+(Y(I)-Y(I-1))/(X(3KIRK943
000028
                      11) - X(I-1)
000029
000030
                       DO 45 I=1.N
                    45 CURV(I)=((1.+SLOPE(I)**2)**1.5)/ABS(EM(I))
000031
000032
                        IF (SRW) 50,100,50
                    50 WRITE (6,1000) N. (X(I),Y(I),SLOPE(I),EM(X),CURV(I),I=1,N)
000033
000034
                   100 RETURN
                  1000 FORMAT (*1*,15HMO. OF POINTS =,13/10X,1HX,19X,1HY,19X,5HSLOPE,15X, 3KIRK94
000035
000036
                      A2HEM, 15X, 4HCURV/(5E20.8))
000037
                       ENU
```

```
DATE 19 MAY 72 PAGE
                   1KIRK • 427825 • 1 • 100
      @ ELT SPLINT,1,720519, 31509
000001
                        SUBROUTINE SPLINT (N.Z.YINT, MAX)
000002
000003
                 C/ SPLINT CALCULATES INTERPOLATED POINTS AND DERIVATIVES
000004
                    FOR A SPLINE CURVE
000005
                        DIMENSION Z(1000), YINT(1000)
000006
                        COMMON /SPLFIT/
000007
                               G(100),SB(100),EM(50),SLOPE(50),CURV(50),X(50),Y(50)
800000
                   1000 FORMAT (* SPLINT USED FOR EXTRAPOLATION**E15.7/)
000009
                        D0140I=1.MAX
000010
                        K=2
000011
                        IF(Z(I)-X(1))70,60,90
000012
                     60 \text{ YINT(I)} = \text{Y(I)}
000013
                        SK=X(K)-X(K-1)
000014.
                        GO FO 130
000015
                     70 IF (Z(I)-(1.1*X(1)-0.1*X(2))) 75,120,120
000016
                     75 WRITE (6:1000) Z(I)
000017
                       GO TO 120
000018
                     80 K=N
000019
                        IF (Z(I)-(1.1*X(N)-0.1*X(N-1))) 120,120,85
000020
                     85 WRITE (6,1000) Z(I)
000021
                        GO TO 120
                     90 IF(Z(I)-X(K))120,100,110
6000622
                    100 \text{ YINT(I)} = \text{Y(K)}
000023
000024
                        SK=X(K)-X(K-1)
000025
                        GO TO 130
                    110 K=K+1
000026
                        IF(K-N)90,90,80
000027
                    120 CONTINUE
[000028]
000029
                        5K=X(K)-X(K-1)
000030
                        YINT(I)=EM(K-1)*(X(K)-Z(I))**3/6. /SK+EM(K)*(Z(I)-X(K-1))**3/6. 3KIRK 41
                       1/SK+(Y(K))/SK-EM(K)*SK/6. )*(Z(I)-X(K-1))+(Y(K-1))/SK-EM(K-1)*SK/6.3KIRK "2
[000051]
000032
                       2 > (X(K) - Z(I))
                    130 DYDX =-EM(K-1)*(X(K)-Z(I))**2/2.0 /SK+EM(K)*(X(K-1)-Z(I))** 2/2.359R2.4
000033
000034
                       1 /SK+(Y(K)-Y(K-1))/SK-(EM(K)-EM(K-1))*SK/6.
                        D2YDX=(X(K)-Z(I))*EM(K-1)/SK+(Z(I)-X(K-1))*EM(K)/SK
000035
                        RCURV=((1.+DYDX**2)**1.5)/ABS(D2YDX)
000036
000037
                    140 CONTINUE
000038
                    500 RETURN
000039
                        END
```

		1K1RK,427825,1,100	DATE 19 MAY 72 PAGE 92	
		TVTVVALENDEDVILVEDV		•
		CDL 17 1 700010 31100	1	* Carto, . /
	9 EF1	SPLNT,1,720519, 31494		
	000001	SUBROUTINE SPLNT (N.SURF.Z.J.MAX.L.LREC.XC.)	C+SLO+RCURVE+SLENTH)	
	000002	c /	•	
	000003	C SPLINT CALCULATES INTERPOLATED POINTS AND DEPIL	ATIVES 3KIRN990	
	000004	C FOR A SPLINE CURVE		•
	000005	INTEGER SURF DIMENSION Z(1000).LREC(6).XC(1000.2).YC(1000	-21-51 0/1000-21-	
	000006			
	000007	1RCURVE(1000+2)+SLENTH(2) COMMON /SPLFIT/ G(100)+SB(100)+EM(50)+SLOPE	50), CURV(50), X(50),	,
	800000	1Y(50)		
	000009	COMMON IM. ID. IY. TITLE (20) DATA (28) XB. YB. NBI	.NBBI	
	000010	WOLTE (C. 1030) IM. ID. IY		•
	000012	1030 FORMAT ('1DATE '.A2.'-',A2.'-',A2.36X.'BLADI	PROFILE PROGRAM'/)	
	000013	WRITE (6,1040) TITLE	4	į.
	000014,	1040 FORMAT (1X,20A4/)	·	;
	000015	WRITE (6, 1050) SURE	ADE CUREACE 1.11)	
	000016	1050 FORMAT (INTERPOLATED X-Y COORDINATES FOR	STANE PORENCE . LITI	1
	000017	IF (MAX) 500,500,5		
_	000018	5 III=SRW	3KIRK 18	
	000019	D0140I=1,MAX	# 15 TO 15 T	
	000020	J=J+1 K=2	3KTPK 19	
	000021 000022	IF(Z(I)-X(1))70,60,90	3K1KK 20 .	*
	000023	60 YINT =Y(1)		
	000025	SK=X(K)-X(K-1)	3KIRK 22	
	000024	60 TO 130	3KIRK 23	
	000026	70 IF (Z(I)-(1.1*X(1)-0.1*X(2))) 75,120,120		
	000027	75 KRITE (6,1000) Z(I)	3KIRK 26	······································
	000028	SRW=16	JAINA EO	
	000029	60 TO 120		
_	000030	$\frac{80 \text{ K=N}}{1 \text{F} \left(Z(1) - (1.1*X(N) - 0.1*X(N-1))\right) 120.120.85}$		
	000031	85 WRITE (6,1000) Z(I)		
	000032 - 000033	SRW=16	3KIRK 31	
	000034	60 TO 120	3KIRK 32	
	000034	90 IF(Z(I)-X(K))120,100,110	3KIRK 33	•
	000035	100 YIHT =Y(K)	17/75V 7E	
	000037	SK=X(K)-X(K-1)	3KIRK 35 3KIRK 36	
	000038	60 TO 130	SKIKK DO	
	000039	110 K=K+1	ė .	
-~	000640	IF(K-N)90,90,80	3KIRK 39	
	000041	120 CONTINUE	3KTRK 40	
_	000042	SK=X(K)-X(K-1) YINT =EM(K-1)*(X(K)-Z(I))**3/6. /SK+EM(K)*(Z(I)-X(K-1))**3/6. 3KIPK 41	•
	000043	1/SK+(Y(K)/SK-EM(K)*SK/6.)*(Z(I)-X(K-1))+(Y(K-1)/SK-EM(K-1)*SK/6.3KIRK 42	•
	000044 000045	2)*(X(K)-Z(I))		
	000045	130 XC(J,L)=Z(I)		
	000048	VC/ LIV-VINT		
	000047	DYDY = -FM(K-1)*(X(K)-Z(Y))**2/2.0 /SK+ZN	(K)*(X(K-1)-Z(I))**2/2.3KIRK 44	
-	000049	1 /SK+(Y(K)-Y(K-1))/SK-(EM(K)-EM(K-1))*SK/6	•	
	000050	SLOCIAL NEDYDY		a
	000051	D2YDX = (X(K) - Z(I)) *EM(K-1)/SK + (Z(I) - X(K-1)) *	FM/K// SK	<u></u>
_	000052	RCURV=((1.+DYDX**2)**1.5)/ABS(D2YDX)		
	000053	RCURVE (J.L) = RCURV		
_	000054	IF(I-1) 155,155,160		
	000055 000056	155 WRITE (6,1010) N,MAX		•
		60 TO 170		

:

.

		
		• .
,		CONTRACTOR OF THE PERSON OF TH
SKIRK ST	7050 FORMAT(6E20.8)	70000 70000
SHRCURY-INTERPOL.,SX,16HSLENTH-INTERPOL.	SY FXY TRHDSLDX-INTERPOL. SX 11HX-INTERPOL.	790000 790000 790000
GIVEN =.13,30H, NO. OF INTERPOLATED P	7 IEI4.6) 5 1010 FORMAT (22H NO. OF POINTS NO. SEL = 1010 FORMAT (-2000 <u>0</u> -20000
EXTRAPOLATION. EXTRAPOLATED VALUE = .3KIRK 52	SETURN COOL STATE OF	(50000 350000 550000
(;QSVDX+RCURV+SLENTH(L)	3	350000 50000
DATE 19 MAY 72 PAGE 93	TRIBK+427025+1+100 TRIBK+42702041(1)+50RI((2)	50000
	1	

DATE 19 MAY 72 PAGE IKIRK, 427825, 1, 100 @ ELT SPLN2,1,720519, 31490 SUBROUTINE SPLN2 (N.SURF, Y1P, YNP) 000001 INTEGER SURF 000002 3KIRK952 000003 3KIRK953 SPLN22 CALCULATES FIRST AND SECOND DERIVATIVES AT SPLINE POINTS 000004 3KIRK954 C END CONDITION - DERIVATIVES SPECIFIED AT END POINTS 000005 COMMON /SPLFIT/ G(100), SB(100), EM(50), SLOPE(50), CURV(50), X(50), 000006 1Y(50) 000007 COMMON IM.ID.IY.TITLE(20).DATA(28).XB(2,25).YB(2,25).NBL.NBBI 000008 WRITE (6,1010) IM, ID, IY 000009 1010 FORMAT ('1DATE ', A2, '-', A2, '-', A2, 36X, BLADE PROFILE PROGRAM'/) 000010 WRITE (6,1005) TITLE 000011 1005 FORMAT (1X+20A4/) 000012 WRITE (6,1020) SURF 000013 1020 FORMAT (* INPUT SPLINE POINTS FOR SURFACE * . I1) 000014 58(1)=0.5 000615 3KIRK960 F=(Y(2)-Y(1))/(X(2)-X(1))-Y1P000016 G(1)=F*3. /(X(2)-X(1))000017 3KIRK962 600018 MO=N-1 IF (NO-2) 20,7,7 000019 000020 7 D0101=2.N0 A=(X(I)-X(I-1))/6.000021 C=(X(I+1)-X(I))/6.000022 v=2. *(A+C)-A*SB(I-1)000023 3KIRK968 SB(I)=C/W 0.00024 F = (Y(I+1)-Y(I))/(X(I+1)-X(I))-(Y(I)-Y(I-1))/(X(I)-X(I-1))3KIRK969 000025 **3KIRK970** 10 G(I)=(F-A*G(I-1))/W 000026 20 F=YNP-(Y(N)-Y(N-1))/(X(N)-X(N-1))3KIRK971 000027 y=(X(N)-X(N-1))/6. *(2. -58(N-1)) 000028 EM(N) = (F - (X(N) - X(N-1)) *G(N-1)/6.)/W 000029 **3KIRK974** 00301=2:11 000030 3K FPK 975 000031 K=11+1-I 30 EN(K)=G(K)-SB(K)*EM(K+1) 600032 SLOPE(1)=(X(1)-X(2))/6. *(2. *EM(1)+EM(2))+(Y(2)-Y(1))/(X(2)-X(13KIRK977)000033 1)) 000034 D040I=2.N 000035 40 SLOPE(I)=(X(I)-X(I-1))/6. *(2. *EM(I)+EM(I-1))+(Y(I)-Y(I-1))/ 000036 _0000**37**_ (X(I)-X(I-1))DO 45 I=1.N 000038 45 CURV(I)=((1.+SLOPE(I)**2)**1.5)/ABS(EM(I)) 000039 WRITE (6,1000) N, (X(I),Y(I),SLOPE(I),EM(I),CURV(I),I=1,N) 0000040 RETURN 000041 1000 FORMAT (16H NO. OF POINTS = 13/10x, 1HX, 19X, 1HY, 19X, 5HSLOPE, 15X, 3KIRK94 240000 A2HEM, 15X, 4HCURV/(5E20.8)) 000043 3KIRK986 GM3 · 000044

```
DATE 19 MAY 72 PAGE 95
                  1KIRK, 427825, 1, 100
      @ ELT STAK, 1, 720519, 31502
                        SUBROUTINE STAK (L. RAD, LREC, XHT, YHT, YCENT, TITLE, IM, ID, IY,
000001
                       1xTRAN, YTRAN, XC, YC, XSH, YSH, XST, YST)
000002
                        DIMENSION LREC(6).TITLE(20).XX(2).YY(2).XC(1000.2).YC(1000.2).
000003
                       1xSH(1000,2),YSH(1000,2),XST(1000,2),YST(1000,2)
000004
000005
                      5 FORMAT (4E20.9)
                     10 FORMAT (6F10.0)
000006
                     20 FORMAT (2F20.8)
000007
                   1000 FORMAT('1DATE ',A2,'-',A2, '-',A2,36X' BLADE PROFILE PROGRAM'/)
800000
                   1005 FORMAT (1X,20A4)
000009
                   1010 FORMAT (42X, WRAPPED BLADE COORDINATES, HUE, UPPER SURFACE,
000010
                       1//9X, 1X1, 19X, 1Y1/}
000011
                   1015 FORMAT (42X. * WRAPPED BLADE COORDINATES. HUB. LOWER SURFACE ..
000012
                       1//9x, 1X1, 19X, 1Y1/)
000013
                   1020 FORMAT (42X, 'WRAPPED BLADE COORDINATES, TIP, UPPER SURFACE',
000014.
                       1//9X, 'X', 19X, 'Y'/)
000015
                   1025 FORMAT (42X, WRAPPED BLADE COORDINATES, TIP, LOWER SURFACE',
000016
                       1//9X,'X',19X,'Y'/)
000017
                   1030 FORMAT (20A4)
000018
                   1035 FORMAT (15)
000019
                   1045 FORMAT ( * X-Y COORDINATES OF HUB CENTROID, X=*.F20.8.*Y=*.F20.8/) . .
000020
000021
                        GO TO (30,60),L
                     30 RADH=RAD
000022
                        READ (5,10) XHT, YHT, XCENT, YCENT, XTRAN, YTRAN
000023
                        WRITE (2,1030) TITLE
000024
                        DO 50 J=1.2
000025
                        ICONT=0
000026
                        WRITE (6,1000) IM, ID, IY
000027
                        WRITE (6,1005) TITLE
7000028
                        IF (J-1) 35,35,40
000029
                     35 WRITE (6,1010)
000030
                        WRITE (6.1045) XTRAN, YTRAN
000031
                        XTRAN=XTRAN-XCENT
000032
                        60 TO 45
000033
                     40 WRITE (6,1015)
~00u034
                     45 N=LREC(J)
000035
                        WRITE (2,1035) N
000036
                        LREC (J+2)=N
-000037
000038
                        DO 50 I=1.N
                        ICONT=ICONT+1
000039
000040
                        X=XC(I,J)
000041
                        Y=YC(I,J)
                        Y=Y-YCENT
000042
                        Y=RADH+SIN(Y/RADH)+YTRAN
000043
                        X=X+XTRAN
000044
000045
                        XX(ICONT)=X
000046
                        YY(ICONT)=Y
000047
                        X=\{U,I\}H\{ZX\}
                        YSH(I,J)=Y
000048
                        IF (ICONT-2) 46,47,47
000049
                     46 TF (I-N) 50,47,47
000050
                     47 WRITE (2,5) (XX(IN), YY(IN), IN=1, ICONT)
000051
000052
                        ICONT=0
                     50 WRITE (6,20) X,Y
000053
                        GO TO 200
000054
                     60 RADT=RAD
[000055]
000056
                        WRITE (2,1030) TITLE
```

		1KIRK,427825,1,100	;	DATE	E 19 MAY 72 PAGE	96	
	000057	00 100 J=1.2 ·	· ·	S. J. F. J. A.			
	000057 000058	ICOMT=0	, ,				
	000059 000060	WRITE (6.1000) IM,ID,IY WRITE (6.1005) TITLE IF (J-1) 65.65.70	Υ				
	000061 000062 000063	65 WRITE (6,1020) 60 TO 75					
-	000064	70 WRITE (6,1025)	/				•
	000065 000066	75 N=LREC(J) WRITE (2,1035) N				•	
	000067 000068	DO 100 I=1.N ICONT=ICONT+1					• *
	000069 .	X=XC(I.J)					
	000070 000071	Y=YC(I,J) Y=Y-YCENT+YHT					
	000072	Y=RADT*SIN(Y/RADT)+YTR	AN		· · · · · · · · · · · · · · · · · · ·		
	000973 000074,	X=X+XHT+XTRAN XX(ICONT)=X			4		i
	000075	YY(ICONT)=Y			***************************************		
	000076 000077	X=(L+1)T2X Y=(L+1)T2Y					
	000078	IF (ICONT-2) 80:85:85 80 IF (I-N) 100:85:85					
	000079 000080	85 WRITE (2,5) (XX(IN),YY	(IN) .IN=1.ICONT)				
	000031 000082	ICONT=0 100 WRITE (6,20) X.Y				•	
	000033	200 RETURN	•				
	000084	END			:	*	
				•		•	
-							
					<u> </u>		
_		· · ·				•	
	· · · · · · · · · · · · · · · · · · ·						
_							•
					•	.3	
				•		8	
			•	•			•
					•		
					,	•	•
_							
			•				
_							
	•					•	
	•		•				

```
DATE 19 MAY 72 PAGE
                  1KIRK,427825,1,100
      N ELT VELIN: 1:720519, 31488
                        SUBROUTINE VELIN (N)
000001
                        DIMENSION DATA(28) TITLE(20) N(2)
000002
                        COMMON /SPLFIT/ G(100) .SR(100) .EM(50) .SLOPE(50) .CURV(50) .XXX(50) .
000003
                       1YYY(50)
000004
                        COMMON IM. ID. IY. TITLE DATA . X (2.25) . Y (2.25) . NBL . NBBI
000005
                        EQUIVALENCE (DATA(1), GAM), (DATA(2), AR), (DATA(3), T1P), (DATA(4),
000006
                       18HOIP), (DATA(5), WTFL), (DATA(6), OMEGA), (DATA(7), ORF), (DATA(8),
000007
                       2BETAI), (DATA(9), BETAO), (DATA(10), CHORD), (DATA(11), STGR),
800000
                       3(DATA(12), REDFA), (DATA(13), DENTO), (DATA(14), RI1), (DATA(15), RO1),
000009
                       4(DATA(16), UETI1), (DATA(17), BET01), (DATA(18), SPLN1), (DATA(19), RI2),
000010
                       5(DATA(20), RO2), (DATA(21), BET12), (DATA(22), BET02), (DATA(23), SPLN2)
000011
                        FOULVALENCE (DATA(24),PO), (DATA(25),W ), (DATA(26),
000012
                       1RAU) + (DATA(27) + CP) + (DATA(28) + W2)
000013
                      5 FÖRMAT (20A4)
000014
                     10 FORMAT (F10.3,2F10.1,2F10.6,10X,F10.2,F10.6)
000015
                     20 FORMAT (2F10.3,2F10.6)
000016
                    30 FORMAT (F10.2,F10.6)
000017
                     40 FORMAT (215,10X,415)
000018
                     50 FORMAT (2F10.6,2F10.3,F10.1)
000019
                     60 FORMAT (8F10.7)
000020
                   1000 FORMAT ('1DATE ',A2,'-',A2,'-',A2,36X,'BLADE PROFILE PROGRAM'/)
000021
                   1005 FORMAT (1X+20A4/)
000022
                   1020 FORMAT (40X, *VELOCITY DISTRIBUTION PROGRAM INPUT DATA*/)
000023
                   1110 FORMAT (7X,3HGAM,14X,2HAR,13X,3HTIP,12X,5HRHOIP,12X,4HWTFL,11X,6H
000024
                             *10X * SHOMEGH * 12X * 3HORF)
้นบบ025
                   1040 FORMAT (1X,F16.6,F16.2,F16.3,2F16.7,10X .F16.2,F16.5/)
000026
                   1120 FORMAT (6X, SHBETAI, 10X, SHBETAO, 11X, 6HCORDF, 11X, 5HSTGRF)
000027
                   1121 FORMAT (2F16.5,2F16.7/)
ີ້ແວຍກ28ັ
                   1125 FORMAT (6X,6HPEDFAC,10X,6HDENTOL)
000029
                   1126 FORMAT (2F16.7/)
000030
                   1130 FORMAT (41H MBI MBO MM NBBT NBL NRSP)
000031
                   1010 FORMAT (215,10X,415/)
000032
                                      BLADE SURFACE 1 -- UPPER SURFACE)
                   1140 FORMAT (40H
000033
                   1180 FORMAT (7X.2HRI.11.12X.2HRO.11.12X.4HBETI.11.11X.4HBETO.11.11X.5HS
000034
                       IPLNO, II)
000035
                   1181 FORMAT (2F16.7,2F16.5,F16.1/)
000036
                   1190 FORMAT (7X, 3HMSP, I1, 2X, 5HARRAY)
000037
                   1191 FORMAT (1X:8F16.7/)
000038
                   1200 FORMAT (7X+4HTHSP+I1+2X+5HARRAY)
000039
                                        BLADE SURFACE 2 -- LOWER SURFACE)
                   1150 FORMAT (39H
0000040
                   1210 FORMAT (7X:8HMR ARRAY)
000041
                   1220 FORMAT (7X,11HRMSP ARRAY)
000042
                   1230 FORMAT (7X:11HBESP ARRAY)
000043
                        SPLN1=N(1)
000044
000045
                        5PLN2=N(2)
                        OMEGA=2.*3.14159*OMEGA/60.
000046
000047
                        RAU=RAD/12.
                        AR=32.174*AR
000048
                        RHOIP=PO+144./T1P/AR
000049
                        WIFLEWIFL/32.174/NBL
000050
                        WU=W*SIN(BETAI/57.296)
000051
000052
                        WX=W*COS (BETAI/57.296)
                        U=RAD*OMEGA
000053
                        VU=WU+U
000054
                        V=SURT(VU**2+WX**2)
000055
                        T1=T1P-V **2/(2.*32.174*778.16*CP)
000056
```

		DATE 19 MAY 72 PAGE 98
	a street to the second	1KIRK: 427825:1:100 DATE 19 MAY 72 PAGE 98
	000057	P1=P0*(T1/T1PJ**(GAM/(GAM-1.))
	000058	RH0=P1*144./T1/AR
	000059	AN=WTFL/RHO/WX
	000050	PITCH=2.*3.14159*RAD/NBL
_	000061	/ HI=AN/PITCH
	000062	/ H2=H1
	000063	/ WX2=W2*COS(BETAO/57-296)
	000064	TTR=T1+W**2/(2.*32.174*778.16*CP)
	000065	PTR=P1*(TTR/T1)**(GAM-1.))
	000066	T2=TTR-U2**2/(2.*32.174*778.16*CP)
	000067	P2=PTR*(T2/TTR)**(GAM/(GAM+1.))
	000068	RH02=P2*144./T2/AR
	000069	AN2=VTFL/RH02/WX2
	000070	H3=AH2/PITCH
	000071	H4=H3
	000072	CHORD-CHORD/15.
	000073	SJGR=STGR/RAD/12.
	000074,	no 200 f=1.2
_	000075	K = N (I)
	000076	00 200 J=1.K
	000077	X(I,J)=X(I,J)X12.
	000078	200 Y(I,J)=Y(I,J)/RAD/12.
	000079	RI1=RI1/12.
	000080	RI2=RI2/12•
	000031	P01=F01/12.
	000032	R02=R02/12•
	000083	HT=PITCH/NBBI
	000084	MUM=CHORD/HT MBI=15
	000085	MBO=NUM+MBI
	000036	MM=MS0+15
_	000087 000088	PRS-4
	000089	X1=-14.*HT
	000009	X2=0.0
-	000091	X3=CHORD
	000092	X4=14.*HT+CHORD
	000093	WRITE (2.5) TITLE
-	000094	WHITE (2.10) (DATA(I).I=1.7)
	000095	WRITE (2,20) (DATA(I),I=8,11)
	000096	WRITE (2,30) (DATA(I), I=12,13)
-	000097	WRITE (2,40) MBI-MBO-MM-NBBI-NBL-NRSP
	000098	WRITE (2,50) (DATA(I),I=14,18)
	000099	J=1
	000100	205 IF (N(1)-J-7) 210,210,215
	000101	210 MAX=N(1)
	000102	60 TO 220
	000103	215 MAX=J+7
	000104	220 WRITE (2,60) (X(1,1),I=J,MAX)
	000105	J=MAX+1 T= (N(1)-NAY) 205.225.205
	000106	IP (W(I)-PAX) 223/223/203
	000107	225 J=1
	000108	230 IF (N(1)-J-7) 235,235,240
	000109	235 MAX=N(1)
	000110	60 To 245
	000111	240 MAX=J+7 245 WRITE (2,60) (Y(1,1),I=J,MAX)
	000112	245 WRITE (2,60) (*(1,1),1=0,4MAX)
	000113	IF (N(1)-MAX) 250,250,230
	000114	250 WRITE (2,50) (DATA(I), I=19,23)
	000115 000116	720 MM (5 (5) 20) (DM/M/17/1-19/20)
		U <u>↓</u>

		1K1RK,427825,1,100	DATE 19 MAY 72 PAGE 99
•		055 VE (N/O) 1-71 260 260 265	A Name of the Contract of the
_	000117	255 IF (N(2)-J-7) 260.260.265 260 MAX=N(2)	
,	000118	60 TO 270	
	000119 000120	265 MAX=J+7	
	000121	/270 WRITE (2,60) (X(2,1),1=J,MAX)	
	000121	/ J=MAX+1	
	000123	IF (N(2)-MAX) 275,275,255	
	000124	275 J=1	
	000125	280 IF (N(2)-J-7) 285,285,290	
	000126	285 MAX=N(2)	
	000127	GO TO 295	
	000128	290 MAX=J+7	
	000129	295 WRITE (2.60) (Y(2.1).1=J.MAX)	
_	000130	J=MAX+1	
	000131	IF (N(2)-MAX) 296,296,280	
	000132	296 WRITE (2,60) X1,X2,X3,X4	
-	000133	WRITE (2,60) RAD, RAD, RAD, RAD	I
,	000134	WRITE (2,60) H1,H2,H3,H4	
	000135	WRITE (6,1000) IM, ID, IY	
	000136	WRITE (6,1005) TITLE	
,	000137	WRITE (6,1020)	
_	000138	WRITE (6,1110)	
-	000139	WRITE (6,1040) (DATA(I), I=1,7)	
)	000140	WRITE (6.1120)	
_	000141	WRITE (6,1121) (DATA(I), I=8,11)	•
	000142	WRITE (6,1125)	
>	000143	WRITE (6,1126) (DATA(I), I=12,13)	
	000144	WRITE (6,1130)	
	000145	WRITE (6,1010) MBI,MBO,MM,NBBI,NBL,NRSP	
)	000146	WRITE (6,1140)	
-	000147	U=1 MAX=M(1)	
	000148	WRITE (6,1180) J,J,J,J,J	
2	000149 · 000150	WRITE (6,1181) (DATA(I),I=14,18)	•
	000150	WRITE (6,1190) J	
~	000151	WRITE (6,1191) (X(1,1), I=1, MAX)	
)	000152	WRITE (6,1200) J	
-	000154	WRITE (6,1191) (Y(1,1),1=1,MAX)	
•	000155	WRITE (6,1150)	
,	000156	J=2	•
-	000157	MAX=N(2)	
`	000157	WRITE (6,1180) J.J.J.J.J	
9	000159	WRITE (6,1181) (DATA(I), I=19,23)	
-	000160	WRITE (6,1190) J	· ·
3	000161	WRITE (6,1191) (X(2,1), I=1, MAX)	
_	000162	WRITE (6,1200) J	
-	000163	WRITE (6,1191) (Y(2,1),1=1,MAX)	-
)	000164	WRITE (6,1210)	
	000165	WRITE (6,1191) X1,X2,X3,X4	
-	000166	WRITE (6,1220)	
•	000167	WRITE (6,1191) RAD.RAD.RAD.RAD	
•	. 000168	WRITE (6,1230)	
-	.000169	WRITE (6,1191) H1,H2,H3,H4	
)	000170	DO 300, I=1.2	
•	000171	K=N(I)	
-	000172	00 300 J=1⋅K	
)	000173	300 X(I,J)=12.*X(I,J)	· · · · · · · · · · · · · · · · · · ·
	000174	RETURN	
	000175	FND	

13. MULTISTAGE AXIAL FLOW TURBINE PERFORMANCE ANALYSIS PROGRAM

MULTISTAGE AXIAL FLOW TURBINE PERFORMANCE ANALYSIS PROGRAM

1. INTRODUCTION

- a. A computer program has been developed for performance analysis of multistage axial flow gas turbines. Its primary purpose is for predesign analysis of axial flow turbines to establish turbine operating characteristics, pressures, temperatures, gas velocities, flow channel geometry, and approximate blade root stresses.
- b. Included is Report 7740R-70-032 which describes the program in detail and includes a listing of the program, input instructions, and example case.
- c. The program is complete and was used for predesign performance analysis of the NERVA turbine.
- d. The program is application as long as the turbine remains axial flow.

e.

f. This program was developed by K. G. Kirk.

2. CONCLUSIONS

a. Gross Conclusions

- (1) This program evolved over the past several years of NERVA work. It proved to be an extremely valuable tool, both in the parametric phase of component selection and the final turbine design.
- (2) The blade root stress predictions of the program required prior knowledge of the blade geometry, hence it was not extremely useful in predesign calculations.

3. RECOMMENDATIONS

- a. Since the program has evolved over a several year period and was originally written for a small scale computer with limited storage, there is room for improvement in the coding to make a cleaner more efficient program.
- b. The program has been used principally in connection with rocket engine turbopump applications; however, there are no known program limitations which prevent its use on any other axial flow gas turbine application.

4. REFERENCES

The method of analysis used in the turbine loss analysis is based on the work of Reference (a).

(a) Stewart, Warner L.; A Study of Axial-Flow Turbine Efficiency Characteristics in Terms of Velocity Diagram Parameters; ASME Paper Number 61-WA-37.

NERVA THREE-STAGE AXIAL FLOW TURBING PERFORMANCE AND AERODYNAMIC ANALYSIS REFERENCE TURBOPUMP

Approved by:

S.A. Leven

S. A. Lorenc, Supervisor Turbounchinery Section Engineering Department NRO

W. E. Campbell, Manager Turbomachinery Section Engineering Department Prepared by:

K. S. Kish

K. G. Kirk, Engineer Turbomachinery Section Engineering Department NRO

I. INTRODUCTION

The three-stage axial flow turbine discussed here is the result of' an extensive turbopump parametric analysis, including turbopump structural and reliability considerations, leading to the following turbine requirements:

Shaft Horsepower = 7,280

Turbine Inlet Temperature = 1,660°R

Turbine Inlet Pressure = 305 psia

Turbine Pressure Ratio = 7.01 (Total to Static)

Rotative Speed = 19,000 rpm

The basic design philosophy maintained for this turbine and those which preceded it during the parametric study included the following:

- 1. Insure impulse or slightly positive reaction at the blade root by selecting some small amount of reaction at the mean line.
- 2. Twisted blades are unnecessary because the NERVA turbine blades are relatively short.
- 3. Maintain constant rotor tip diameter for all stages to maximize tip speed for the first stage which has lower blade stresses, to reduce the total turbine rotor overhung moment and to simplify the turbine housing.
- 4. Distribute stage loading such that the first stage produces the most work and the last stage produces the least. This assures turbine flow control by the first stage nozzle, resulting in more reliable off-design performance predictions without sacrificing turbine performance.
- 5. A single tangential inlet line and dual tangential exhaust lines are used, with line sizes being selected as a compromise between line weight and pressure losses.

II. METHOD OF ANALYSIS

Performance analysis for the turbine centers around the method of predicting losses for both the blading and associated inlet and exhaust ducting. The loss analysis selected for the blading is similar to that of Reference (1) and includes these several major assumptions.

- 1. One-dimensional flow at the mean radius.
- 2. Adiabatic flow through static components, i.e., manifolds and nozzles.
- 3. Blading losses may be satisfactorily predicted on the basis of
 - a. Reynolds Number
 - b. Nozzle Exit Angle
 - c. Average Kinetic energy level of the stage
 - d. Rotor Tip Clearance

Losses in the inlet manifold and exhaust collector are based on a total pressure loss coefficient.

Utilizing the required shaft power and assumed turbine flow rate, (which eventually must satisfy the pressure ratio requirement) the specific work requirement of the turbine is determined from the relation

$$\overline{\triangle}_{h} = \frac{\text{SHP } 550}{\hat{\mathbf{w}} \quad \mathbf{J}} \tag{1}$$

and is distributed to each individual stage in a manner consistant with the basic design philosophy.

For the turbine considered here, the stage loading is:

First Stage 40%

Second Stage 33%

Third Stage 27%

Further reduction in last stage loading would result in insufficient axial acceleration of the flow.

Selection of nozzle angles is based on the following criteria:

- 1. Performance
- 2. Blade Height
- 3. Flow Passage
- 4. Manufacturing Feasibility

Use of hot hydrogen drive gas tends to result in short turbine blades, especially for the first stage, and a pronounced rotor tip clearance effect on turbine performance. Hence, a high nozzle angle (measured from the axial direction) is desirable for the first stage to produce maximum blade length, however, excessively high nozzle angles degrade performance because of the increased wetted area, and increases manufacturing difficulty. These considerations have led to a first stage nozzle angle of 75 degrees. The remaining nozzle angles of 70.5 degrees for the second stage and 66 degrees for the third stage were selected to produce a reasonably good flow passage within the constant rotor tip diameter constraint.

First stage blade speed was selected primarily to satisfy critical speed considerations by maintaining low disc weight. The trade-off between disc weight and turbine performance has led to a first stage mean blade speed of 1200 ft/sec. Remaining stage blade speeds satisfy a constant tip configuration resulting in an average blade speed of 1185 ft/sec.

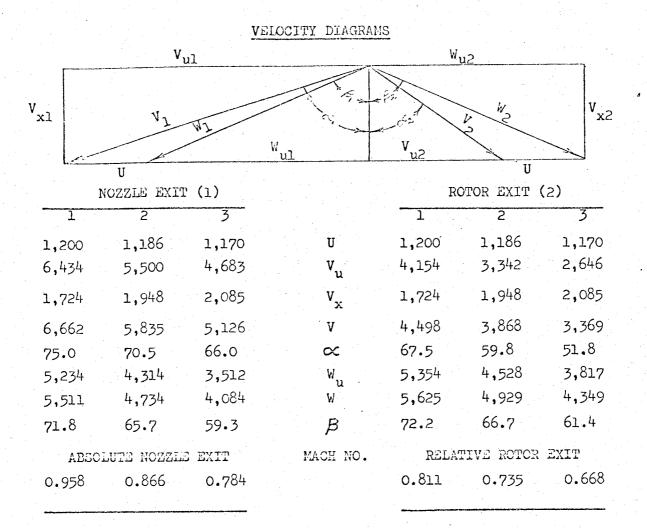
The above parameters, namely stage load, nozzle angle, degree of reaction and blade speed dictate the gas velocities for the stages and with the gas velocities determined, the blade loss analysis is conducted resulting in interstage pressures and temperatures as well as blade heights and efficiencies. The loss coefficient used for the blade loss analysis was based on data presented in Reference (1) together with correlations made with the M-1 scale model fuel pump test data and NASA three-stage turbine test data. Inasmuch as the effect of rotor tip clearance on stage loss is a function of rotor blade height, it was necessary to provide for blade loss coefficient variation from stage to stage. This was done based on tip clearance leakage data presented in Reference (2).

Loss coefficients for the inlet manifold and exhaust collector were based on limited data obtained from the technology turbopump.

In order to facilitate the parametric study that has been made on the NERVA turbine, the above performance analysis procedure has been computerized. A detailed report on this turbine performance program is currently being written and will be published as "Design Point Performance Analysis of Multistage Turbines," RN-TM-O411. A brief preliminary explanation of the program and its use together with an example case are included as Appendix B.

The results of this analysis for the three-stage turbine considered here are summarized as follows:

		FIRST STAGE	SECOND STAGE	THIRD STAGE	THREE STAGE
Flow Rate	Lb/Sec	4.05	4.05	4.05	4.05
Pressure Ratio (Total-to-Static)	2.519	2.169	1.808	7.01
Velocity Ratio	U/Co	0.147	0.164	0.190	0.106
Actual Enthalpy Drop	BTU/Lb	508	419	342	1,269
Static Efficiency	%	38.1	40.3	45.6	51.7



A complete computer output for the base case is included as Appendix A.

The above aerodynamic analysis is, of necessity, a predesign analysis; following it, the blade profiles are designed to satisfy the velocity triangle requirements. Once the blade profiles have been generated two more phases of the turbine aerodynamics are executed. First a detailed blade loss analysis based on blade section properties is made using Soderberg's Method. The performance prediction from this method of analysis is compared with the pre-design analysis and any significant discrepancies are resolved through blade profile and/or clearance modifications. Secondly, the surface velocity distribution is analyzed for adverse diffusion characteristics using the NASA velocity distribution program.

Design of the NERVA turbine has not progressed to the point of conducting these final aerodynamic design studies, however, the final turbine design will have these considerations incorporated.

REFERENCES

- 1. A Study of Axial-Flow Turbine Efficiency Characteristics in Terms of Velocity Diagram Parameters, by Warner L. Stewart, ASME Paper 61-WA-37
- 2. Experimental Investigation of Three Tip-Clearance Configurations

 Over a Range of Tip Clearance Using a Single-Stage Turbine of

 High Hub-to-Tip Radius Ratio, by Milton G. Kofskey, NASA TMX-472.

APPENDIX A

BASE CASE

COMPUTER PRINTED OUTPUT

*	2044

3 STAGE

89-61-T03TA0

009*I 099*I 002*I	HACD SECTION OTTA: CONST. CONST	TY LOSS COSFF, TO COSF 1.25 C C C C C C C C C C C C C C C C C C C	JAIXA NA∃M CONTROL 1010A CONTROL 1010A CONTROL 1000 CONTR	10N ANGLE LOAD 10N ANGLE RATIO 100 1.000 10.50 0.825	35AT2 35AT2 TTA29 1 0.0 1 20.0 5 20.0 5
		E INPUT PARAMETERS	DATE		
		X DATA SWITCHES ON	PARAMETER INDE	MATERIAL DENSITY LB/CU-1N 0.300	SIRESS LIMIT PSI S0000,0
		000°E 000°T	00 1°000	0°0000E 00 0°0000	TO 300001*0
	IENI	OVERSPEED FACTOR OVERSPEED EXPO		ISTSIG ASEA DISTRI	
	E.C. LOSS CUEFFICIENT 5.000	MEAN BLADE ROIATIVE MAN, LOSS SPEED SPEED COEFFICIENT FT/SEC RPM 1200.0 0.750	INLET TOTAL SAURESAG A129 0.306	FLOW INLET TOTAL RATE TEMPERATURE LA/SEC DEG R 4.05 1660.0	7280.0 НОВЅЕРОWER SHAFT
		ASE CONDITIONS)		
	ABSOLUTE VISCOSITY LB/FT-SEC 0.1340E-04	CONSTANT PRESSURE SPECIFIC HEAT BIU/LB-DEG R 3.504	SPECIFIC HEAT RATIO 1.391	GAS CONSTANT FT/DEG R 766.137	
		GAS PROPERTIES			
	50 - 0810	S BOCKET ENGINE	an an	NON TURBINE, NERV CS-+-SINGLE SPOOL TURBI	CHARACIERISIT
83	CASE NUMBE				
		PO NUMBER 1 OF 1 PAREYSIS PORBINE DESIGN			

DATE07-19-68

STAGE VELOCITIES

PAGE 2

NON TWISTED BLADES

s	STAGE 1	FT/SEC 1161.2 1200.0 1238.7	VU1 FT/SEC 6587.3 6432.7 6285.3	VX1 FT/SEC 1765.1 1723.6 1684.1	V1 FT/SEC 6819.7 6659.6 6507.1	WU1 FT/SEC 5426•1 5232•7 5046•6	W1 FT/SEC 5706.0 5509.2 5320.2	VU2 FT/SEC -4353.7 -4152.7 -3972.2	VX2 FT/SEC 1775.9 1723.6 1678.0	V2 FT/SEC 4701.9 4496.2 4312.1	WU2 FT/SEC -5514.9 -5352.7 -5211.0	*2 FT/SEC 5793.8 5623.4 5474.5	0.039 0.050 0.055
	2	1132.3 1185.5 1238.7	5693.4 5498.5 5317.3	2016.1 1947.1 1883.0	6039.9 5833.1 5640.9	4561.1 4313.0 4078.5	4986.8 4732.2 4492.2	-3560.8 -3340.9 -3150.0	2018.9 1947.1 1887.9	4093.3 3866.9 3672.4	-4693.1 -4526.4 -4388.8	5109.0 4927.4 4777.6	0.055 0.058 0.040 0.126
	3	1101.7 1170.2 1238.7	4895.9 4581.5 4486.6	2179.8 2084.3 1997.5	5359.3 5124.5 4911.2	3794.2 3511.2 3247.9	4375.8 4083.3 3813.0	-2868.0 -2645.2 -2457.5	2168.6 2084.3 2019.2	3595.6 3367.7 3180.7	-3969.7 -3815.5 -3696.3	4523.4 4347.7 4211.8	0.076 0.130 0.186

NON TWISTED BLADES

STAGE	ABSOLUTE	RELATIVE
	NCZZLE EXIT	ROTOR EXIT
1	0.985	0.839
	0.958	0.811
	0.932	0.787
2	0.902	0.765
	0.866	0.734
	0.833	0.710
	t_i	
3	0.824	0.697
	0.783	0.668
	0.747	0.645

26.13- 36.13- 36.13-	-52.99 -51.76 -50.59	21.03 04.88 04.88	00•99 00•99	E79*9E	ĭ ⊅ ĭ *€€	978•0	Z+L*0	6720.T	1	
ZL*99- ZL*99-	90*65- 96*65- 77*09-	TZ*59 0L*59 ST*99	02.07 02.07 02.07	L+8•8Z	966*+7	279°0	ESS*0	1051.7	2	ر د _{اری} : راید: (۱۱۱)
51.27- 21.15- 21.27- 21.27- 21.27-	60*19- 67*19- 930	11°2¢ 11°1¢ 11°6¢ 11°6¢	75.00 75.00 75.00	812•12 NI-08	67 1 • 91 NI - 05	195°0 NI	996.0	ETES.T	T	,
SEIFS	SAHGJA	£AT38	ALPHAI	ANNULUS S ABRA	ANNULUS AREA I	BLADE	BLADE HEIGHT 1 IN	MEAN RADIUS NI	30AT2)
				BLADES	NON TWISTED	i v				
PAGE ¢				YATE	ATAGE GEOM				89-61-1031	٧a

DA"	E07-19-	68	PR	ESSURE\$					2	TEMPERA	TURES	P40E 5
					NC	N TWISTED	BLADES					
	STAGE	PT1 PSIA 272•7	P1 PSIA 146.8	PT2 PSIA	P2 PSIA	PRS	PRT	*****	TT1 DEG R	T1 DEG R	TT2 DEG R	73 283 R
		272.7 272.7	151.5 155.9	158.8 157.2 155.9	116.6 118.6 120.4	2.518	1.900		1660.0 1660.0 1660.0	1394.9 1407.2 1418.6	1515.1 1515.2 1515.1	1989.1
	2	137.3 137.3 137.3	81 • 2 84 • 3 87 • 2	91.7 90.7 90.0	71.3 72.5 73.5	2.168	1.732		1515.2 1515.2 1515.2	1307.2 1321.2 1333.8	1395.7 1395.7 1395.6	1912 1913.8 1918.7
	3	83.9 83.9 83.9	53.8 56.0 58.0	60.8 60.2 59.7	49.4 50.2 50.8	1.807	1.507		1395.7 1395.7 1395.7	1232.0 1246.0 1258.2	1298.2 1298.0 1297.6	171+.8 1233.8 11-1.0

								A CONTRACTOR	
ATE07-19-6	8			s	TAGE PERF	ORMANCE			
STAGE	LAVDA	DEL H BTU/LB	ETS	ETT	U/CO				
1	0.113	507.3	0.381	0.528	0.147				
2	0.134	418.5	0.403	0.550	0.164				
3	0.159	342.4	0.456	0.642	0.190				
				ÖVERA	II BLADE I	PERFORMANCE			
				O TENA	CE CEADE ,	EN ONESTICE			
DEL H	UMA FT/SEC	n\co	U/C01	PRS1	PRTT	ETST	ETTT	RET	RES
1268.4	1185.2	0.110	0.115	5.953	4.964	0.552	0.601	1.068	1.077
1.0			OVERA	LL TURBINE	PERFORMA	NCE INCLUDI	NG MANIFOLD	.	
4									
0.110	0.114	PRST 6∗075	PRTT 5.065	ETST 0.548	ETTT 0.595			4 to 1	
		OVERALL	TURBINE	PERFORMANC	E INCLUDIA	NG MANIFOLD	AND EXHAUS	ST COLLECTO	R
U/CO 0,106	U/CO' 0.108	PRST 7.011	PRTT 6.589	ETST 0.517	ETTT 0.530				
			*						
				INLET	MANIFOLD	CONDITIONS			
AREA	MACH NUM	ρ	Ŧ	PTME					
SQ-IA 11.48	0.200	PSIA 296•6	DEG-R 1647.1	PS1A 298.8					
			EXI	HAUST COLLI	ECTOR EXIT	FLANGE CO	NDITIONS	-	
AREA SQ-IN	MACH NUM	PT PSIA	PSIA	TT DEG R	T DEG R				
45.94	0.300								
42074	0.500	46 • 2	43.5	1298.0	1275.5				

PAGE &

SSBATS	KOOL	BONDO	V0.10V		

;	3*71761	6.265	17029.8					
			9 95021	0.75	487.0	6450.4	ε	
	1*8987T	1725.3	5.64161	0 * 8 8	£65 ° 0	1051•4		
	Z*4490T	8.621	7°E826	0 • 0 +	9 1 7°0		 	
	10142 513ESS PSI	5A1GA38 223972 129	CENTRIPETAL STRESS PSI	STAGE LOAD PERCENT	BLADE HEIGHT IN IN	SUIDAR MI ETES•T		
					, AVEDACE	MEAN	35AT&	
4	3049		000					

89-61-T03TAG

APPENDIX B MULTISTAGE AXIAL FLOW TURBINE

PERFORMANCE ANALYSIS PROGRAM

ABSTRACT

A computer program has been developed for performance analysis of multstage axial flow gas turbines. Its primary purpose is for predesign analysis
of turbines to establish turbine operating characteristics, pressure, temperatures, gas velocities, flow channel geometry and approximate blade root stresses.
The program has been used principally in connection with rocket engine turbopump
applications, however there are no known program limitations which prevent its
use on any other axial flow gas turbine application.

This program is in the IBM 1130 version of Fortran IV.

A. PROGRAM DESCRIPTION

This computer program has been devised for parametric analysis of multistage, single or two-spool, axial flow gas turbines. Because of the fact that a large number of independent variables are considered during parametric analysis of turbines and because of the many mathematical relations involved (some requiring numerical solution), it was necessary to employ a high-speed digital computer. The program is in the IBM 1130 version of Fortran IV and is used on that machine. All major parameters consistent with conventional gas turbine design have been included in the analytic procedure. Specific information determined by the program includes the following:

- 1. Velocity diagrams
- 2. Mach numbers
- 3. Flow channel geometry
- 4. Gas state at each axial station
- 5. Performance
- 6. Blade root stresses

B. METHOD OF SOLUTION

The analysis utilized in this program is based on the following major assumptions:

- 1. One-dimensional flow at the mean radius
- 2. Subsonic and/or transonic flow
- 3. Adiabatic flow in stators

The loss analysis used in the performance section of the program is a modified version of that discussed by Stewart in Reference (1). In this loss analysis blade row losses are assumed to be a function primarily of the average kinetic energy of the blade row. Hence, specification of the velocity triangle for a stage through the specific work requirement, stage reaction, nozzle discharge angle and blade speed leads to turbine performance and associated parameters such as gas state.

Inlet manifold and exhaust collector losses are calculated using a total pressure loss coefficient defined by

$$Y_{p} = \frac{Po_{1} - Po_{2}}{Po_{2} - P_{2}}$$

where

Yp = Total pressure loss coefficient

Po, = Inlet total pressure

Po₂ = Exhaust total pressure

P₂ = Exhaust static pressure

These two component losses are included in over-all turbine performance.

Although performance is based on a one dimensional analysis at the mean line, the radial variation of flow properties based on the mean line values is determined assuming simple radial equilibrium.

This is accomplished for either of the following two types of blading:

- 1. Free Vortex
- 2. Non-twisted

Determination of the radial variation of flow properties serves at least these three purposes;

- 1. Evaluation of axial bearing loads
- 2. Evaluation of blade gas bending loads
- 3. Evaluation of blade root reaction

Distribution of work between stages is specified by the "stage load ratio" defined as follows:

$$X_{i} = \frac{\triangle h_{i}}{\triangle h_{1}}$$

where

X; = Stage load ratio of stage i

 Δh_i = The specific work of stage i

 $\triangle h_1$ = The specific work of the first stage

Obviously the stage load ratio for the first stage is always one (1).

The meridional curvature of the turbine is determined by the "mean radius ratio" defined by

$$Y_{i} = \frac{U_{m_{i}}}{U_{m_{i}}}$$

where

Y, = The mean radius ratio of stage i

Um, = Mean blade speed of stage i

 U_{m_1} = Mean blade speed of stage 1

Also for the first stage this parameter is always one by definition.

Axial acceleration of the flow across the rotor is given by the "axial velocity ratio" defined as

$$Z_{i} = \frac{Vx_{2,i}}{Vx_{1,i}}$$

where

 Z_i = the axial velocity ratio of stage i

 $Vx_{1,i}$ = rotor inlet axial velocity of stage i

 $V_{x_{2,i}}$ = rotor exit axial velocity of stage i

In addition to the aero-thermal aspects of the program, provision is made for determining blade root stress for each rotor. Blade root stress is determined for uniform cross section blades, hollow blades, tapered blades or a combination of hollowing and tapering. The radial distribution of blade cross section area is given by

$$\frac{A(r)}{A_b} = B + C \emptyset + D \emptyset^2$$

$$\emptyset = \frac{\mathbf{r} - R_{\mathbf{h}}}{R_{\mathbf{T}} - R_{\mathbf{h}}}$$

$$\hat{\xi} = \frac{R_b - R_h}{R_p - R_h}$$

where

A(r) = blade cross section area at any radius r

A_b = blade cross section area at the point where area begins to change

B = constant

C = constant

D = constant

r = radius corresponding to A(r)

R_h = hub radius

 R_{m} = tip radius

R_b = radius at which area begins to change

Ø = non-dimensional radius

 δ = \emptyset at which area begins to change

The centripetal stress equation is then dependent only on the constants B, C, D and \S . Although the precise blade geometry will generally not be known in the initial turbine design phase, the required constants may be determined from a similar family of blades with reasonable accuracy. If the blades are of uniform cross section, then

B = 1

C = 0

D = 0

and the stress equation is independent of & .

Assuming symetrical beam bending, the bending stress at the blade root is given by

$$\frac{M}{b} = \frac{M}{Z}$$

where

ob = bending stress

M = bending moment

Z = section modulus

and the section modulus is assumed to be

$$Z = \mathcal{E} Ct^2$$

where

 ξ = section modulus constant

C = blade chord

t = blade thickness

The bending stress equation can then be reduced to a form which is dependent on the following blade properties:

Solidity

Aspect Ratio

Thickness/Chord ratio

Section modulus constant (ξ)

If a blade were of rectangular cross section then

$$\xi = 1/6$$

For actual blades, 5 may be only fifty or sixty percent of this theoretical value.

The stress calculation may be done at a speed other than that for which nominal performance is done. The speed at which stress is determined is given by

$$N_s = N_n \times F_{os}$$

where

 $N_s = stress speed (or overspeed)$

N n = nominal speed

F = overspeed factor

The power used for gas bending stress is then given by

$$SHP_s = SHP_n \times F_{os}^E$$

where

SHP = stress shart power

SHP_n = nominal shaft power

Eos = overspeed exponent (normally 3 for turbepumps)

Special features of the program provide for the following:

- 1. Specification of turbine pressure ratio or turbine weight flow rate, whichever is considered independent.
- 2. Internal modification of the meridional flow curvature to give all rotors the same tip diameter.
- 3. Internal modification of one of the following parameters to arrive at some blade root stress limit:
 - a. Rotative speed
 - b. Mean blade speed
 - c. Pressure Ratio
 - d. Inlet pressure
 - 4. Single turbine or two turbines in series (two spool).

The maximum number of stages per turbine is ten (ten for each spool in the two spool configuration).

The above discussion is only a brief explanation of the methods employed in this program and is intended to provide the minimum information necessary for program use. A complete report with all equations and numerical solutions employed (AGC RN-TM-0411, Design Point Performance Analysis of Multi Stage Turbines) is currently being written.

C. OPERATING INSTRUCTIONS

Two types of cases should be considered in the following discussion. The first which is the basic case contains all information necessary for the case to be executed and must be the first case for any given job losting. The second type of case may not be used as the first case and is used to change one or more parameters in the previous case. This provides a convenient method of stacking cases, requiring only a few cards. Base cases may also be stacked and is advised if a large number of parameters are to be changed. Loading of each type of case is discussed in detail in the following section. All options are controlled by either a flag or a data switch.

1. Base Case

The card format for each data card is shown on the attached loading sheets (Fages 18, 19, and 20).

Parameters appearing on each card are as follows:

- CARD 1 The date is placed on this card using three two digit fields.
- *(1) Month
 - (2) Day
 - (3) Year

Leading zeros should be used where necessary to make two digits.

CARD 2 - This card is for gas property data.

~				
(4)	Gas constant	•		ft/OR
くワー	out our our			/

- (5) Specific heat ratio ---
- (6) Constant pressure specific heat BTU/lb OR
- (7) Absolute viscosity lb/ft sec

These first two cards are unique in that this data may not be altered for successive stacked cases in a given job load.

- *NOTE: Circled numbers are parameter numbers and correspond to load sheet numbers.
 - <u>CARD 3</u> This card is for an identifying case number consisting of any six alpha-numeric characters.
 - (8) Case number
 - CARDS 4, 5, and 6 These three cards are title cards and may contain any alpha-numeric data. This information has been divided into three categories (one for each card).
 - (9) Turbine Application (Card 1)
 - Turbine Characteristics (Card 2)
 - (Card 3)

- CARD 7 This card is for the six option control flags and number of spools (one or two). The values to be assigned each flag for the desired case options are shown on page 25.
- Radial velocity distribution option flag
- (13) Stress option flag
- Index page option flag This option provides for printing a duplicate of the case input data, identical to the first page of output, to be used for filing purposes.
- Typewriter option flag If one of the stress adjusting options is selected (via flag 13), intermediate values of the adjusting parameter may be observed on the 1130 console typewriter during the adjusting cycle. This is a diagnostic device and is controlled by this flag.
- (16) Pressure ratio option flag
- Number of spools
- Case flag indicates whether next case is a change case or base case.
- CARD 8 The required pressure ratio is placed on the card. If

 flag 16 is option five (5), this card <u>must</u> be omitted.
- (19) Pressure ratio

The next two cards contain information which is independent of whether the case is for a single or two-spool configuration.

CARD 9

- 20 Turbine flow rate lb/sec
- 21 First spool, first rotor mean blade speed ft/sec
- A value must be input for this parameter regardless of whether an exhaust collector exists on the turbine analyzed or not. Its value must be greater than zero (0) and less than one (1).

Defined as the ratio of first spool last rotor mean blade
radius to second spool first rotor mean blade radius. If
the case is for a single spool, any value may appear in
this field.

(24)	Inlet	total	temperature		\circ_{R}
25	Inlet	total	pressure		psia

Spool radius ratio

Inlet manifold flange Mach number required as is parameter

27 Inlet manifold total pressure loss coefficient --- defined on page 2.

CARD 10

Exhaust collector total pressure loss coefficient --defined on page 2.

Parameters 27 and 28 must be input but may be zero (0) in which case the losses of the manifold and/or exhaust collector are zero.

Inlet tangential velocity ft/sec

This parameter is used only if data switch two is up.

Its primary use is in single spool analysis of the second spool of a two spool pair where the tangential velocity component leaving the first spool is known.

<u>CARD 11</u> - This is the first card containing individual spool information. Specifically it contains information pertaining to stress calculations and <u>must</u> be omitted if flag 13 is opiton five (5).

30	Rotor material density lb/in ³
31	First spool rotor stress limit psi
32 32	Over speed factor
	defined on page 5.

(33)	Over s	speed	expor	nent
	define	ed on	page	5.

(34) Delta defined on page 3.

CARD 12

45

(35)	Shaft power of spool	Нр
36)	Rotative speed of spool	RPM
(37)	Number of stages in spool	***

The next series of cards contain information pertaining to individual stages. Each card must have as many values as there are stages. Additional values will be ignored.

00 x6m0100	
CARD 13	
38	Stage reactions
CARD 14	
(39)	Stage nozzle angles Degrees
CARD 15	
40	Stage load ratios - defined on page 2
CARD 16	
41	Mean radius ratio - defined on page 3.
CARD 17	
42	Axial velocity ratios - defined on page 3
CARD 18	
43	Nozzle blade loss coefficients
	defined in reference (1)
CARD 19	
44	Rotor blade loss coefficients
	defined in Reference (1)
CARD 20	

in.

Rotor tip clearence

CARD 21

(46)

Rotor aspect ratio

CARD 22

47

Rotor thickness/chord ratio

CARD 23

48

Rotor solidity

CARD 24

49

Rotor blade section modulus constant --- defined on page 5.

CARD 25 - This card has the coefficients determining the blade radial cross sectional area distribution. They are the coefficients of a quadratic equation as defined on pages 3 and 4.

(50) Constant term

51 Linear term coefficient

Quadratic term coefficient

For a constant cross section blade, the following parameter values must be used:

34 = 1.0

50 = 1.0

51 = 0.0

52 = 0.0

Cards 21 through 25 contain information pertaining to the stress analysis portion of the program only. They may be omitted if flag 13 is option five (5) but must be included if blade root stress is desired.

The above cards constitute a complete base case for a single spool turbine. If there are two spools cards 11 through 25 must be repeated for the second spool.

Additional base cases may be stacked by starting over with Card 3.

This requires flag 18 to be two (2) for each case preceding a base case.

For a change case flag (18) must be one (1) on the preceding case and the following cards make up the change case:

CARD la - This card contains a new case number.

- 8 Case number
- CARD 2a This card contains the number of parameters to be changed and the code number of each.
- Number of parameters to be changed
- (54) Parameter code numbers (as many as indicated by (53)).

Code numbers for each parameter appear on pages 21 through 24 together with restrictions on their use. Code numbers should not be confused with circled parameter numbers.

CARD 3a

New parameter values

New parameters must appear in the same order as the corresponding code numbers on Card 2a, one parameter per card except for parameters with code numbers thru 46 (see page 24).

In addition to those options controlled by the flags on Card 7, other options may be exercised through use of the IBM 1130 Console data switches.

Switch 1 is used to control the type of velocity triangle. The normal selection is with this switch off (down) and this normal switch position should be used almost exclusively.

Switch 2 is used in conjunction with the inlet tangential velocity (parameter 29) and must be on whenever it is desired to input this parameter.

Switch 3 is used to control the constant tip radius option. It causes internal adjustment of the mean radius ratio of successive stages after the first until all rotors have the same tip radius.

For switch positions and their effect, see page 26.

D: RESTRICTIONS

This program is restricted to a maximum of ten stages per spool. The blade loss analysis includes no provision for shock losses, therefore use of the program should be restricted to subsonic and transonic flow.

Selecting the option of controlling blade root stress by internal adjustment of mean blade speed should be done with caution since blade root stress is relatively insensitive to blade speed, at constant rotative speed, and only small adjustments can be made.

E. TIMING (IBM 1130 COMPUTER)

Initial loading of the program requires approximately seven (7) minutes in object deck form. Execution of each case thereafter requires between two (2) and ten (10) minutes depending on the number of stages and the options selected.

F. STORAGE REQUIREMENTS

The core-storage requirement of the mainline program and all of its associated subroutines is approximately 20000 word bits. However, the program is used on the IBM 1130, with only 5000 (aprox.) word bits of core storage, by maintaining the subroutines on a "load on call" (LOCAL) basis.

G. LISTING

A listing of the program with all control cards required for compilation, production of an object, deck and execution of the program on the IBM 1130 computer is attached. Data cards for the following example case are also listed at the end of the program following the "LOCAL" cards.

H. EXAMPLE CASE

The printed output for an example case is attached to exemplify the information generated by the program. This case is for a twin-spool case with seven (7) stages on the first spool and three (3) stages on the second spool. Hydrogen gas properties are used for this case.

Input data for the case is listed on page one (1) and the optional index page of the output. Some of the parameter values listed here may differ from the values appearing on the input data cards. This is the result of program modification of certain input data to satisfy specified options. In any case, the data printed on the first page is consistent with the remaining information generated by the program. Two additional pieces of input information, inlet manifold and exhaust collector Each numbers, appear on succeeding pages of the output.

Listed on page two (2) of the output are the blade and gas velocities. The radial distribution used (free vortex or non-twisted blades) is listed at the top of this page and on all other pages where it has an effect on the parameters listed. The velocities or velocity components are given for three radial blade positions; hub, mean, and tip; in that order.

The absolute nozzle exit and relative rotor exit Mach numbers are printed on page three (3), again for three radial blade positions.

Mean rotor radius, blade heights, annulus areas, and gas angles are given on page four (4).

On page five (5) pressures and temperatures are given at the various axial stations. One (1) denotes stator exit conditions and two (2) denotes rotor exit conditions.

Turbine performance is listed on page six (6) with individual stage performance preceding over-all performance.

Stress information is given on page seven (7) for each rotor.

If the case is for a two-spool configuration (as is this example), then pages one (1) through seven (7) are repeated for the second spool as pages eight (8) through fourteen (14). Over-all two-spool performance is given on page fifteen (15) and is based on the following four (4) loss configurations:

- 1. Both spools excluding manifold and exhaust collector losses.
- 2. Both spools including manifold losses.
- 3. Both spools including exhaust collector losses.

4. Both spools including manifold and exhaust collector losses.

Farameters listed on the printed output in symbolic form which are not explained elsewhere are defined as follows:

Page 2 and 9 Outrut

U = Mean blade speed

VUl = Stator exit tangential gas velocity component

VXI = Stator exit axial gas velocity component

Vl = Stator exit gas velocity

WUl = Rotor inlet relative tangential gas velocity component

W1 = Rotor inlet relative gas velocity

VU2 = Rotor exit absolute tangential gas velocity component

VX2 = Rotor exit absolute axial gas velocity component

V2 = Rotor exit absolute gas velocity

WU2 = Rotor exit relative tangential gas velocity component

W2 = Rotor exit relative gas velocity

Page 4 and 11 Output

Blade Height 1 - Stator trailing edge blade height

Blade Height 2 - Rotor trailing edge blade height

Annulus Area 1 - Stator trailing edge annulus area

Annulus Area 2 - Rotor trailing edge annulus area

Page 5 and 12 Cutput

PT1 - Stator exit total pressure

Pl - Stator exit static pressure

PT2 - Rotor exit total pressure

P2 - Rotor exit static pressure

TTI - Stator exit total temperature

Tl - Stator exit static temperature

TT2 - Rotor exit absolute total temperature

T2 - Rotor exit static temperature

STAGE PERFORMANCE

LAMDA - Stage Work-Speed Farameter (Reference 1)

DEL H - Stage Specific Work

ETS - Stage Total to Static Efficiency

MTT - Stage Total to Total Efficiency

U/Co - Stage Isentropic Spouting Velocity Ratio

OVER-ALL BLADE PERFORMANCE

(No manifold or exhaust collector losses)

DEL H - Over-all turbine specific work

UMA - Average mean blade speed

U/Co - Over-all isentropic spouting velocity ratio (based on static pressure ratio)

U/Co - Over-all isentropic spouting velocity ratio (based on total pressure ratio)

PRST - Over-all total to static pressure ratio

PRTT - Over-all total to total pressure ratio

ETST - Over-all total to static efficiency

ETTT - Over-all total to total efficiency

RET - Total reheat factor

RES - Static reheat factor

Following the above performance data is essentially the same information including the manifold loss (page 6) or exhaust collector loss (page 13).

INLET MANIFOLD CONDITIONS

AREA - Inlet manifold flow area

P - Static pressure corresponding to inlet conditions and inlet Mach number

- T Static temperature corresponding to inlet conditions and inlet Mach number
- PIME Manifold exit total pressure

REFERENCE:

(1) Stewart, Warner L.; A Study of Axial-Flow Turbine Efficiency Characteristics .

In Terms of Velocity Diagram Parameters; ASME Paper Number 61-WA-37.

		10 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	أياد فسيويينه أأدار السيديية	
The state of the s			with market of the parties of the same	77 - 1
EL CASO - SAGATE CA CALLAN DIAN SA CHAM	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		PARAMO S POLITIS	7 - 1 - 1
ZI G-YO		(25)) []	(4)
\$1.01.1 1.	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SECULO ES OF SECULO	Sais Miles S	
		(35) (15)	
TT CEYO THIS OWN AND WAR ESD EXPORENT, DELIN, THIS CARD AND THE TH		SHATE TAL DENSITY STRESS	HHUMARU SSAGES	Great and
PLITITITIES CARROLEGED EXPONENT DELLA	11111111111	(68		(32)
or sho			rolastop ssor Bolos	1,75,18.7.4
	1-	(2)	}	(0)
$(z) \qquad (z) $		The state of the s	AET SPOOL 1st St. 18E	र देशस्य जाड
TEMP., INLET TOTAL PRES., INLET WANT. FLANZE AREA, MANI. LOSS COERFICIENT	TAINT SALIS SALIS, INLET FOTAL	IN BLADE SP., EXH. PLANCE MA		Arm of the state o
	11111111111111111	1111111111111		(61)
(Arth 학교 Arth	11311111111111	1111111111	OTTER PARS	
	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	+ + + + + + + + + + + + + + + + + + + +	(7)	1 7.5
4 GBY?	S.C. (AI) (AI)	i leivo w jeivo keivo	STOORS SO RE-NIM & S	TO CHE LEIVE
	OFFICE INFO		(ττ)	
9 GEVO	CHVELERIZETICS	411111111111111111111111111111111111111	11112311	
S GAX3		41111111111		سوي و با سال تيليسا د از از ا
7 CEYO	APPLICATION	4111111111111	Hard (86 chiekottek	Santasa.
	111111111111111111	11111111	11111-	13/
E GRASO	11111111111111111			
	1111111111111111	1 1 1 1 1 1 1 1 1 1 1 1		Aderry dead
	SLYSL OS FIRST CASE	1111111111	1111111	111:
				-
C GAVO	1, [1,1,4]	(S)		(7)
	SOSSIA JUNIOSAY LVAN DIRIDAAS JANSSAAA	PECIFIC HEAT BATIO, CONSTANT	E CAS CONSTANT; S	
RECUIRED FOR EACH LOAD OF THE PROCESSAL		. , , , <u>, , , , , , , , , , , , , , , ,</u>		OCC
	, , , , , , , , , , , , , , , , , , ,		EVSX XVO	1 1
25 0 2 18 2 12 10 2 12 12 12 12 12 12 12 12 12 12 12 12 1	SA ASPASA DE LA CAROLES ASPASA DE LA COLOR ASPASA DE LA CAROLES AND MANAGES.	92 52 72 52 52 53 54 \$1 41 41 51	FIRE CLASS COM	OVILLY S.S
The state of the s	DENOTED BY CIRCLED NUMBERS.	ATAC DIMERIC MARRIC DAY. THEOLIE INC. THEOLIE INC.		
THUR LOTTE	CS TS MIST HE RICHT ADJUSTED WITH NO DE	SA AND THE IAST PARAMETER	int in it it scri	o so vita
		CAS TURBIAN DESIGN FREGUENS		8368 5 63
30 8/ 83/3/v 31 v 30 v 3 v 3 v 3 v 3 v 3 v 3 v 3 v 3 v	William Schild		3111 180438	8 16 8 7 603
	हुदुक्ता दिए, मुंदरक्रकेम् होताकार, प्रदेशकार विकास करणा है। इद्युक्ता दिए, मुंदरक्रकेम होताकार, प्रदेशकार विकास करणा है।			
	grapher in a sing the property of the training and the control of	The second of th	rent rojali jiroj	

0.7

(ONIL IS W = 5) REED VS WYNX AVEREZ VS 21VCES CVG ST CASO SE M SE TITITION ON TO THE TITITION ON THE TITITION ON THE TITITION ON THE TITITION ON THE TITITION ON THE TITITION OF T ARED AS MARY VALUES AS STROKES of the Carlot Ca S CHAS SERVIN YNAN 2A CHRW MEED VS WANT VALUES AS STAGES CARD 28 INKED VZ WYNX AVINEZ VZ ZLVCEZ THIN ST GENO SHOWLE SY SHITZY ANAN SY GREEK 92 61 CAS. TUTL UNK OF HIGH PROGRAM. #E 8081 111FE

<u> ARTHUR BORNES EN ELL CLICALO EL EL CARROLLO EL CARROLLO EL CARROLLO EL CARROLLO EL CARROLLO EL CARROLLO EL C</u> <u>annaling is a nga diduga kanalaga an angada a libera daliki kaling dalika ingada ingada kanalan</u> bika a Charle de Caratal e la companie de <u>a la cala de la giala de la cala de Cala</u>nde, a mandió de la calanda de la calanda de la calanda de la calanda a de la composição de l en <u>nationale de la completa da completa de la com</u> and the state of t BE WIND PARAPETERS TO BE GIANOR PREVIOUS CASE IN SAME OFFDER AS CODE MUNEERS ON CARD SA, ONE PARAMETER PER CARD EXCEPT STACE PARAMETERS CODE WUNDERS 25 THEO AS. (16 PISLDS, S CHARACTERS EACH Company and an entire and contains and conta a a garagagagagagagaga<mark>ti tertekatkatkatkat tertekatkata terte</mark>katat tertekat tertekat tertekat tertekat tertek IN THIS OFFICH IS SELECTED, THE LAST VARIABLE OF CARD 7 (INFAR) MUST HE SOLLOWING CARDS.

A SECOND OFFICH MAY BE SELECTED BY WAKING INFAR = 1 AND ADDING THE FOLLOWING CARDS. FOR A TWO SPOOL TURBINE (LPIAC = 2) CARDS 11 TO 25 ARE TO BE REPEATED FOR THE SECOND SPOOL ADDITIONAL CASES MAY BE STACKED BY REPEATING CARDS 3 TO 25 ARE LAST SPOOL TURBINE (PARKED BY REPEATING CARDS) TO SEE LAST SACRED BY REPEATING CARDS A SIGNAL OF THE SECOND SPOOL TURBINE ARE TO SECOND SPOOL TURBINE AR

and the contract of the profession of the contract of the cont

BY

MENUJET-DENINAL CHRPORATION SACRAMENTO CALIFORNIA

REPORT NO.

PAGE 21 0-2

DATE

GAS TURBINE DESIGN PROGRAM.

PARAMETER CHANGE CODE SERET.....

2/8/68 WORK ORDER

CHK. BY

K. K	IRK CHK BY	DATE
CCDE NO.	PARAMETER	
1	CHARACTERISTIC TITLE CARD	3
2	OBJECTIVE TITLE CARD.	
3	BLADE TYPE PARAMETER	TITL3
4	STRESS CALCULATION PARAMETER.	
5	INDEX PAGE PRINT PARAMETER	
6	PRESSURE RATIO PARAMETER.	
#7	MUMBER OF SPOOLS	
# # 8	PRESSURE RATIO	IFLAG PREQS; PREQT;
9	FLOW RATE.	PRÇOS; PRÇOT.
10	FIRST STAGE, FIRST SPOOL, MEAN BLADE SPEED.	
11	EYHAUST FIANCE MACH NUMBER	
12	SPOOL MEAN RADIUS RATIO	
13	INLET TOTAL TEMPERATURE.	RFACT
14	INIET TOTAL PRESSURE	TTI (1)
15	FIRST SPCOL SHAFT HORSEPOWER.	PTI (1)
16	SECOND SPOOL SHAFT HORSEPOWER.	SHP (1)
17	FIRST SPOOL ROTATIVE SPEED.	SHP (2)
18	SECOND SPOOL ROTATIVE SPEED.	SP (1)
19	FIRST SPOOL BLADE LOSS CCEFFICIENTS.	SP (2) COE (1,1,1)
20	SECOND SPOOL BLADE LOSS COEFFICIENTS.	COE (1,2,1) COE (2,1,1)
21	FIRST SPOOL MANIFOLD LOSS CCEFFICIENT.	CUE (2,2, I)
22	SECOND SPOOL MANIFOLD LOSS CHEFF. (EXH. COLL/).	COEM (1)
#23	FIRST SPOOL NUMBER OF STAGES.	COEM(2)
75-97.52		N (1)



REPORT NO.

PAGE 22 07 26

2/8/68 WORK ORDER

GAS TURBINE DESIGN PROCESKILL.... PARAMETER CHANGE CODE SHIET.....CONTINUED

3 Y				C	HK. BY	- <u>4</u>	
	K* k	KIRK	•				
			 	 			

K _* K	RK	
CODE NO.	PARAMETER	Fortran symbol
# 24	SECOND SPOOL NUMBER OF STACES	N (2)
25	STAGE REACTIONS, FIRST SPOOL	REA (1,1)
26	STAGE REACTIONS, SECOND SPOOL	REA (2,1)
27	NOZZIE ANGLES, FIRST SPOOL	AD1 (1,I)
28	NOZZLE ANGLES, SECOND SPOOL	AD1 (2,1)
29	STAGE LOAD RATIOS, FIRST SPOCL	X (1,1)
30	STAGE LOAD RATIOS, SECOND SPOOL	X (2,I)
31	MEAN BLADE RATIOS, FIRST SPOOL	Y (1,1)
32	MEAN BLADE RATIOS, SECOND SPOOL	Y (2,I)
33	AXIAL VELOCITY RATIOS, FIRST SPOOL	Z (1,I)
34	AXIAL VELCCITY RATIOS, SECOND SPOOL	Z (2,I)
35	ROTOR TIP CLEARANCES, FIRST SPOOL	CLEAR (1,I)
36	ROTOR TIP CLEARANCES, SECOND SPOOL	CLEAR(2, I)
37	ROTOR ASPECT RATIOS, FIRST SPOOL	ARS (1,I)
3 8	ROTOR ASPECT RATIOS, SECOND SPOOL	ARS (2,I)
3 9	ROTOR THICKNESS/CHORD RATIO, FIRST SPOOL	TCRS (1,1)
40	ROTOR THICKNESS/CHORD RATIO, SECOND SPOOL	TCRS (2, I)
41	ROTOR SOLIDITIES, FIRST SPOOL	SOLD (1,1)
42	ROTOR SOLIDITIES, SECOND SPOOL	SOLID (2,1)
43	ROTOR SECTION MODULUS CONSTANT, FIRST SPCCL	SECON (1,1)
44	ROTCR SECTION MODULUS CONSTANT, SECOND SPOOL	SECON (2,1)
45	ROTOR BLADE AREA DISTRIBUTION, FIRST SPOOL	ARCON (1,I)
46	ROTOR BLADE AREA DISTRIBUTION, SECOND SPCCI	ARCON (2,I)
47	ROTOR MATERIAL DENSITY, FIRST SPOOL	RHO (1)
48	ROTOR NATERIAL DENSITY, SECOND SPCOL	RHO (2)
3	and the state of t	2

DATI 2/8/68 WORK ORDER

GAS TURBINE DESIGN PROGRAM.....
PARAMETER CHANGE CODE SHEET....CONT INUED

K. KIRK

ACC S DROOT I

SUBJECT

CHK BY

DATE

CODE NO.	PARAMETER	FORTRAN SYMBOL
49	STRESS LIMIT	STRL
50	OVERSPEED FACTOR, FIRST SPOOL	OSF (1)
51	OVERSPEED FACTOR, SECOND SPOOL	OSF (2)
52	CVERSPEED EXPONENT, FIRST SPOOL	CSEXP (1)
5 3	OVERSPEED EXPONENT, SECOND SPOOL	CSEXP (2)
54	ROTOR BLADE TAPER DEPTH, FIRST SPOOL	DELTA (1)
55	ROTOR BLADE TAPER DEPTH, SECOND SPOOL	DELTA (2)
56	INLET TANGENT IAL VELOCITY	VULIN
57	INLET FLANGE MACH NUMBER.	ВМАСН
### 58	INPUT PARAMETER	INPAR

RAL CURPURATION

m ráin nó

FALL 24 ... 26

DALL

2/8/CE

K. KIRK

Same of Market 11

SUBTRICE

CHK BY

DATE

NOTES:

#

THESE PARAMETERS MAY HE REDUCED FROM THE BASE CASE BUT MAY NOT BE INCREASED FROM THE BASE CASE.

THIS PARAMETER NUMBER REFERS TO THE FOLIDWING PARAMETER DEPENDING ON THE MOST RECENT VALUE OF MFLAG;

PREQS FOR MFLAG = 1
PREQT FOR MFLAG = 2
PRQOS FOR MFLAG = 3
PRQOT FOR MFLAG = 4

THIS PARAMETER MUST BE CHANGED TO 2 IF A NEW BASE CASE IS TO FOLLOW. (CODE NUMBER IS ALL THAT IS REQUIRED)

IF FARAMETERS 25 THROUGH 46 ARE TO BE CHANGED, THEY MUST BE RESPECTIVED FOR ALL STAGES OF A GIVEN SPOOL.

FOR PARAMETERS 19 AND 20, BOTH ROTOR AND STATOR LOSS COEFFICIENT OF THE SPOOL MUST BE RESPECTFIED.

AFROL'ET	AEROJET-GENERAL SACRAMENTO .	CORPORATION
GINEFAL	SACRAMENIO .	CALIFORNIA

REPORT NO PAGE 25 01 26

2/8/68

WORK ORDER

GAS TURBINE DESIGN PROGRAM......CONTROL FLAGS FOR CARD SEVEN

DATE

AGCS-0800-11 SUBJECT

K. KIRK

CHK BY

GROUP ONE

1 = FREE VORTEX BLADES.

2 = NON TWISTED BLADES.

GROUP TWO

O = STRESS CALCULATED.

1 = STRESS ADJUSTED BY Um.

2 = STRESS ADJUSTED BY Pti.

3 = STRESS ADJUSTED BY Pr.

4 - STRESS ADJUSTED BY N.

5 = STRESS NOT CALCULATED..... (OMIT CARD 11)

GROUP. THREE

1 = PRINT INDEX PAGE.

2 = DO NOT PRINT INDEX PAGE.

GROUP FOUR

1 = TYPEWRITER OUTPUT.

2 = NO TYPEWRITER OUTPUT.

GROUP FIVE

1 = PRESSURE RATIO IS MAIN STATIC.

EXCLUDING EXHAUST COLLECTOR

2 - PRESSURE RATIO IS MAIN TOTAL.

3 - PRESSURE RATIO IS OVERALL STATIC. 4 - PRESSURE RATIO IS OVERALL TUTAL.

5 = NU PRESSURE RATIO REQUIRED..... (OMIT CARD 8)

GROUP SIX

1 - SINGLE SPOOL.

2 = TWO SPOOL.

GROUP SEVEN

1 - NEXT CASE IS CHANGE ONLY.

2 = NEXT CASE IS A COMPLETE CASE.

GROUP EIGHT

ISW=0 - STANDARD VELOCITY TRIANGLE

ISU70- VELOCITY TRIANGLE OPTEON

JSW=0 - Inlet Tangential Velocity =0 GROUP NINE JSW > 0 - Inlet Tangential Velocity Input ON CARD 10

KSW = 0 - ROTOR MEAN LINE MAINTAINED AS IMPLET GROUP TEN KSW70-ROTOR MEAN LINE ADJUSTED FOR CONSTITUTE

LSW = 0 - Input Mach Number for Maritald and E.C. GROUP ELEVEN Low >0 - Input Asie 25



REPORT NO.

PAGE 26 OF 26

CAS TURBINE DESIGN PROGRAM..... DATA SUTTICHES

WORK CROER

K. KIRK

CHK. BY

DATE

SWITCH ONE;

DOWN (STANDARD)..... VELOCITY TRIANGLE, TYPE 1.

.. VETOCITY TRIANGLE, TYPE 2. (OPAICN) ... UP

SWITCH TWO:

. INLET TANGENTIAL VELOCITY IS ASSUMED ZERO AND DOWN (STANDARD). NOT TO BE SPECIFIED ON INPUT CARD NUMBER 10.

. INLET TANGENTIAL VELCCITY IS NOT ZERO AND IS (OPTION). UP TO BE SPECIFIED ON INPUT CARD NUMBER 10.

SWITCH THREE;

DOWN (STANDARD).....ROTOR BLADE MEAN LINE IS MAINTAINED AS

SPECIFIED ON INPUT BY Y(I).

(OPTION)... D5

Not Used ON 1108

SEE NEW FLAGS

SEE NEW FLAGS

PROGRAM

LISTING



```
310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)INPT1028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CAPTION 29
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   NPT 1030
                                                                                                                                                                                                                                                                                                                                        INPT1008
                                                                                                                                                                                                                                                                                                                                                                                                  NPT1010
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NPT1020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         NPT 1024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      INPT1026
                                                                                                                                                      INPTIONZ
                                                                                                                                                                                                                                                                                                                                                                    NPT1009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            MPT1015
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NPT1016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       NPT1018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      910ITUNI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              NPT1021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            NPT1022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          NPT 1023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       NPT1025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      NPT 1027
                                                                                                                                                                                                                                                                                                                                                                                                                                                               NPT1012
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NPT1013
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               NPT1031
                                                                                                                                                                                     NOTION
                                                                                                                                                                                                                                                                           1001Ta
                                                                                                                                                                                                                                                                                                          NPT 1007
                                                                                                                                                                                                                                               CCLL
                                                                                                                                                                                                                                                                                                                                                                                                                                 VPT 101
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       NPTIOI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           MPT103
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          NPT103
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      NPT103
                                                                                                                                                                                                                   MOTION
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          NPT101
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   COMMON NU2T (10) . 3D2T (10) . N2T (10) . REAT (10) . UM (10) . VU1H (10) . ADIH (10)
                         OPERATIONS, AEROJET GENERAL CORP.
                                                                                                                                                                                                                                                                                                         2ETTIM, UMA (2), UCO, UCOM, RET (2), RES (2), PRST (2), PRTT (2), UTS, SUBJAT (31),
                                                                                                                                                                                                                                                                                                                                    3SUMHS (2); PREOS; PREOT; IFLAG; CASEI; CASEZ; JFLAG; KFLAG; HFLAG; LFLAG; LF
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           4AC21(10),11H(10),111(10),12H(10),PIH(10),PIT(10),PZH(10),12T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            365(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    25TRL(2),TUM1,TPT1,TPRST,15P,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                2XU2H(10),BD2H(10),W2H(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                               COMMON X (2,10), Y (2,10), REC (2,20), 7 (2,10), AD1 (2,10), PRSOL, PRIOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           388(12) - TT1(10) - TT2(10) - PRT(10) - PRS(10) - PRN(10) - PT1(10) - PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       710(12), ANI(10), HI(10), ANZ(10), HZ(10), UT(10), VUIT(10), ADIT(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    1.V1H(10).WU1H(10).8D1H(10).W1H(10).WU2H(10).AD2H(10).V2H(10).
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            1V1(10); WHITE 01; VX 1(10); WI (10); WUI (10); VZ(10); VUZ(10); VXZ(10);
PROGRAM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          X2(27)*842(10)*351(10)*AD2(10)*BD2(10)*ETS(10)*ETT(10)*E(10)*
                                                                                                                                                                                                                                                                             ICOEMI(2) *N(2) *DHO(2) *SP(2) *PRSTM(2) *PRITM(2) *ETST *ETTT *ETST **
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CONMON VXZH(10) FRMA(10) (TT2T(10) TT2H(10) PT2T(10) PT2H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     4. SECON(2, 10), ARCON(2, 3), SOLID(2, 10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5V1T(10), WULT(10), BD1T(10), WIT(10), VU2T(10), AD2T(10), V2T(10)
                                                                                                                                                                                                                                                 COMMON IN, ID, IY, R. GAM, CP, MIS, SHP(2), W, TII(2), PTI(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         5P2T(10),COT(10),VEP(101,5DVJ(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CORMON UP(10) * BAS (12), THS (10) * EMACHS IN PAR , IMANI , PMANI ,
AMALYSIS
                                                                                                                                                                                                                                                                                                                                                                                                    ETSMM, ETTMM, PTME(2), AREAE, TECE, PÉCE, PERCT, 1PAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1PT11(10), PT1HC10, TITLI(20), TTTL2(20), TITL3(20);
PERFURMANCE
                                                                                                                                                                                                                                                                                                                                                                                                                                                               IETSOL, ETTOE-UCSOL, UCTOR, UCST, UCGTN, AREAI
                                                                                                                                                                                     SUBROUTINE READS: IN DATE AND GAS PROPERTIES
DESIGN F
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  READ (2,2) IM. ID. IY. R. GAM. CP. VIS
                             K. G. KIRK, DEPT.7740, NUCLEAR
   MULTISTAGE AXTAL FLOW TURBINE
                                                                                                                                                                                                                                                                                                                                                                          4PROOS , PROOT , PRSMM, PRT MM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      FORMAT (3A2/4F10.5)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            LONI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          LICNI
                                                                                                                            SUBROUTINE INPTI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5.4RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  RETURN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   END
                                                                    3/6/68
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             dno //
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           *STORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            dr.nG*
```

U UU

	5		
6.5-			
			: :
201			
- 27			
	-		
	-	•	
	_	۳.	
		~	
		•	
		•	
		٠,	
	1	7	
	-		
		3	
		•	
	~	•	
	_		
	٠.	•	
	~	. •	
	٠,	٧,	
	+	~	
	n		
	•		
	-	•	
	-1		
			4
	ş	-	
		- 6	
	٠.		
	Ł.	_Ť	
		_	
	~=	,,,,	
	~		
	¥	-4	
	>-	••	
	•		
	-	`	
		۰	
	_	•	
	۹.	,	
	_	٠.	
	n	~	
	•		
	CHOMINATE TAID TO	١.,	٠.
		_	
		-)	
	-	÷	
	٤.	^	
		•	
•			
£			
_			
ر ک ک			
ė.			

```
NPT2039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        NPT2041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             INPT2029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NPT2033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             NPT2035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NPT2036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  NPT2038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 NPT2040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  NPT2042
                                                                                                                                             NPT2008
                                                                                                                                                                     NPT2009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NPT2028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NPT2030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NPT2032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NPT2034
                                                                                               NPT2006
NPT2002
                                               NPT2004
                           NPT20.03
                                                                                                                       NPT2007
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             NPT203
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NPT203
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        NP 1204
                                                                        NP7200
                                                                                                                                                                                                                     NPT201
                                                                                                                                                                                                                                                                                                                                                                                                                                        INPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 NPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        NPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               NPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        NPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 NPT-202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       NPT202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               NPT202
                                                                                                                                                                                              NPT201
                                                                                                                                                                                                                                              MPT201
                                                                                                                                                                                                                                                                    NPT201
                                                                                                                                                                                                                                                                                                                                          NPT201
                                                                                                                                                                                                                                                                                                                                                                  NPT201
                                                                                                                                                                                                                                                                                             NPT201
                                                                                                                                                                                                                                                                                                                     NPT201
                                                                                                                                                                                                                                                                                                                                                                                        NPT201
                                                                                                                                                                                                                                                                                                                                                                                                                 NPT201
                                                                                                                                                                                                                                                                                                                                                                                                                                        COMMON WUZT(10), BD2T(10), WZT(10), REAT(10), UH(10), VUIH(10), AD1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             310),STR8(10),STRT(10),COE(2,2,10),CLEAR(2,10);ARS(2,10),TCRS(2,10)
                                                                                                                                                                    35UMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 3GS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                             ZETTIM, UNA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     2STRL(2),TUM1,TPT1,TPRST,TSP,M,RHO(2);NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          2WU2H([0),8D2H(10),WZH(10),REAH(10),Tl(10),T2(10),Pl(10),P2(10),
                                                                                                                                                                                                                                                                                                                                                                                          4PTO(10); ANT(10); HI(10); ANZ(10); HZ(10); UT(10); VULT(10); ADIT(10);
                                                                                                                                                                                                                                             COMMON X (2,10), Y (2,10), REA (2,10), Z (2,10), AD1 (2,10), PRSOL, PRIOL
                                                                                                                                                                                                                                                                                                                                                                    188(10) FTT (10) FTT (10) FRE(10) FRS(10) FRN(10) FTT (10) FTZ(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 1,V1H(10),WU1H(10),BD1H(10),W1H(10),VU2H(10),AD2H(10),V2H(10),
                                                                                                                                                                                                                                                                                                                                          2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10);
                                                                                                                                                                                                                                                                                                                    1V1(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VUZ(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4.SECON(2,10),4ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                                        ICOEMIZA, NIZA, DHQ (21) SP(2) , PRSTM (2) , PRTTM (2), ETST, ETTT, ETSTM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                 5V1T(10), WU1T(10), BD1T(10), W1T(10), VU2T(10), AD2T(10), V2T(10)
                                                                                                  COMMON IN, ID, IY, R, GAM, CP, VIS, SHP(Z), W, TII(Z), PTI(Z), UM1(Z);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  5P2T(10),COT(10),VEP(10),DVU(10),WX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                              CCMMON UM(10) PAS(10) DHS(10) BMACH INPAR, IMANI, PMANI,
                                                                                                                                                                                                                       ETSNM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    IFLAG, M, JFLAG, KFLAG, MFLAG, LFLAG, INPAR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PT1T(10),PT1H(10),TTTL1(20);TTTL2(20);TTTL3(20);
                                                                                                                                                                                                                                                                        ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREA!
                           CASE
                             BASE
                           SUBROUTINE READS IN ALL DATA FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2.23.24.251. MFLAG
                                                  EXCEPT DATE AND GAS PROPERTIES
                                                                                                                                                                                                  4PRODS PROOT PRSNM PRIMM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CASE1, CASE2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 (2F10,5,15)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  TITLI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  (8F10.5)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           (10F8.5)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (A4,A3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           (212)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     (20A4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          READ (2,3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        (5:2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  (2:2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           2,27
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  (2,2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     5.RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  READ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          READ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 READ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          READ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Q
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           4
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              127
```

```
*STORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  READ (2.4) PREQI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               READ (2,4) PREQS
                                                                                                                                                                                                                                                                                                                                                                                                                                                   READ (2.4) PRQOT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           READ (2.4) PROOS
                                                                                                                                                                                                                                                                                                                                                                                                                           READ (2,6) W,UM1(1), EMACH. REACT, III(1), PTI(1), BMACH. COEM(1), COEM(21:PT205)
                                                             CONTINUE
                                                                                                                                      ARCON(L.I)=0.0
                                                                                                                                                                                                                           READ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                GO TO 25
                                                                                                                                                                            READ (2)
                                                                                                                                                                                                               READ
                                                 RETURN
                                                                          SECON(L.I)=0.0
                                                                                                              ARS(L.1) #0.0
                                                                                                                                                               GOTO
                                                                                                                                                                                                                                                                                                                                                                READ (2,4)
                                                                                                                                                                                                                                                                                                                                                                          READ (2,6) RHO(L),STRL(L),OSF(L),OSEXP(L),DELTA(L
                                                                                                                                                                                                                                                                                                                                                                                                                                        GO TO 25
                                                                                                                                                  DO 47 I=1,3
                                                                                                                                                                                                                                                                                        READ
                                                                                                                                                                                                                                                                                                                                                                                                    DO 50 L=1.LFLAG
                                                                                       SOLID(L.1) #0.0
                                                                                                                                                                                                                                                                                                                              REAU
                                                                                                                                                                                                                                                                                                                                                     KUN (L
                                                                                                                          DO 48
                                                                                                                                                                                                                                       (H-W-4)
                                                                                                                                                                                                                                                                                                                                                                                                                ) VULIN
                                                                                                  [CRS(L,I)=0.0
                                                                                                                                                                                                                                                                                                                                                                                        F (M-4) 30,30,35
                                                                                                                          1111
  85
                                                                                                                                                                                                                                                                                                                                                                 SHP(L), SP(L), N(L)
                                                                                                                                                                                                                                                   CCLEAR(L.1).I#1.KJ
                                                                                                                                                                                                                                                                                                                                        (REA(L, I) , I=1,K)
                                                                                                                                                                                                                           (ARS(L.I),I=1.K)
                                                                                                                                                                                                                                                               (COF(L,2,1), [=1,K)
                                                                                                                                                                                                                                                                                                    (Y(L,I),I=1,K)
                                                                                                                                                                                                                                                                                                                (X(L,I),I#1,K
                                                                                                                                                                                                                                                                           (COF(L,l,I),I=l,K)
                                                                                                                                                                                                                                                                                        Z(L,I),I=1,K)
                                                                                                                                                                                                   SOLID(L.
                                                                                                                                                                                                               TCRS(L,I
  INPT2
                                                                                                                                                                                                               ,1=1,六)
                                                                                                                                                                                                                                                                                                                                                                                                                                           INPT205
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  INPT2049
                                                                  INPT208
                                                                                                                  INPT207
                                                                                                                              [MPT2076
                                                                                                                                          INPT2075
                                                                                                                                                      [NPT2074
                                                                                                                                                                  INPT2073
                                                                                                                                                                             NPT2072
                                                                                                                                                                                                                                                                                                                                                                                                        14PT205/
                                                                                                                                                                                                                                                                                                                                                                                                                   CNPTROBE
                                                                                                                                                                                                                                                                                                                                                                                                                                                      INPTPOSO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              MP 72048
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          [NPT204]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       NPT2046
                                                     IMPT2082
                                                                              INPT2080
                                                                                                      INPT2078
                                                                                                                                                                                           MPT207
                                                                                                                                                                                                                                                                  NPT206
                                                                                                                                                                                                                                                                                                                                                                              NPT2056
                                                                                                                                                                                                                                                                                                                                                                                           NPT205
                                                                                           NPT2079
                                                                                                                                                                                                    NPT2070
                                                                                                                                                                                                                              NPT2068
                                                                                                                                                                                                                                                     MPT2066
                                                                                                                                                                                                                                                                                                                   NPT206
                                                                                                                                                                                                                                                                                                                                            SPT205
                                                                                                                                                                                                                  NPT2069
                                                                                                                                                                                                                                          NPT206
                                                                                                                                                                                                                                                                                                      MPT206
                                                                                                                                                                                                                                                                                                                                                       NPT205
                                                                                                                                                                                                                                                                                                                                MPT206
                                                                                                                                                                                                                                                                                                                                                                  NPT205
```

```
INPT3038
                                                                                                                                                                            NPT3008
                                                                                                                                                                                                                                                                                                                                                      NPT3014
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              COMMON WUZT(10),8D2T(10),W2T(10).REAT(10),UH(10),WU1H(10),ADIH(10)INPT3020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                NPT3025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            NPT3026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               310),STR8(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)INPT3029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                NPT3039
                            NPT3003
                                                         NPT3004
                                                                                      NPT3005
                                                                                                                   NPT3006
                                                                                                                                                                                                         NPT3009
                                                                                                                                                                                                                                                                                               MPT3012
                                                                                                                                                                                                                                                                                                                                                                                  NPT3015
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NPT3019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      INPT3023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    1NPT3024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              NPT3030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NPT3032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NPT3033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                INPT3034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                NP T3035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            NPT3036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                NPTS040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NPT3042
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 NPT3043
INPT3002
                                                                                                                                                                                                                                       NPT3010
                                                                                                                                                                                                                                                                                                                          NPT3013
                                                                                                                                               NPT3007
                                                                                                                                                                                                                                                                  NPT3011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            NPT3021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          NPT3041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         NPT3031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      INPT3037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      NPT302
                                                                                                                                                                                                                                                                                                                                                                                                              NPT301
                                                                                                                                                                                                                                                                                                                                                                                                                                          NPT301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      NPT301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        INPT302
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 INPT302
                                                                                                                                                                                                        3SUMHS(2),PREQS,PREQT,IFLAG,CASE1,CASE2,UFLAG,KFLAG,MFLAG,LFLAG,L
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    365(10);UC(10);RMF(10);AC1(10);AC2(10);AC1H(10);AC2H(10);AC1T(10);
                                                                                                                                                                          ZETTTM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  2STRL(2),TUM1,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WE(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 50 TO (20,21,22,23,24,25,26,27,32,34,34,35,36,37,38,39,40,41,42,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ZWUZH(10),BD2H(10),WZH(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                            CCMMON X(2,10), Y(2,10), REA(2,10), Z(2,10), ADI(2,10), PRSOL; PRIOL;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4PTG(10), AN1(10), HI(10), AN2(10), H2(10), UT(10), VUIT(10), ADIT(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                          3RW(10),ITI(10),ITZ(10),PRJ(10),PRS(10),PRN(10),PIJ(10),PTZ(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              1.V1H(10), WU1H(10), BD1H(10), W1H(10), VU2H(10), AD2H(10), V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            4.SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                               [COEMIZ],N(2),DHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT,ETSTM
                                                                                                                                                                                                                                                                                                                                                                                                              2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10)
                                                                                                                                                                                                                                                                                                                                                                                  IVI(10), VUL(10), VXL(10), WI(10), WUL(10), VZ(10), VUZ(10), VXZ(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  5V1T(10), WULT(10), BD1T(10), WLT(10), VUZT(10), ADZT(10), VZT(10)
                                                                                                                   COMMON IN. 10. 1Y. R. GAM, CP, VIS. SHP(2), W, ITI(2), PII(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                5P2T(10) *CGT(10) *VEP(10) *DVU(10) *VX1T(10) *VX2T(10) *VX1H(10)
                                                                                                                                                                                                                                                                                                                                                         COMMON UN(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                  ETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
C SUBROUTINE READS IN NEW PARAMETER VALUES FOR CHANGE CASE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      IPTIT(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20).
                                                                                                                                                                                                                                                                                                                           ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                READ (2,4) NUMBR, (ICODE(J), J=1, NUMBR)
                                                                                                                                                                                                                                           4 PROOS , PROOT , PRSMM, PRTMM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CASEL, CASE2
                                                                SUBROUTINE INPT3 (MI)
                                                                                             DIMENSION ICODE (20)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               DO 200 UHINDMBR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   (10F8.0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          KCODE=ICODE(J)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     (F10.0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             (A4, A3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             (20A4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (1615)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       READ (2,3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                5, RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           K2=N(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 FORMAY
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     FORMAT
```

```
Ω
M
                                                                                                                                                                                                                                                                                                                                                                                                    0
4
                                                                                                                                                       က
က
                                                                                                                                                                                                                                    29
                                                                                                                                                                                                                                                                                                                          24
                                                                                                                                                                                                                                                                                                                                                                                                             .43,44,45,46,47,48,49,50,51,52,5
264,65,66,67,68,69,70,71,72,73,7
                                                                                     READ (2.5)
GO TO 200
                                                                                                                                                                                                                                                                                                                                                                                 READ (2,2)
                                                                                                                                                                          READ (2,5)
                                                                                                                                                                                                               READ (2.5)
                                                                                                                                                                                                                                                                                                                                           READ (2,4)
                                                                                                                                                                                                                                                                                                                                                                                                    READ (2.2)
                                                                           READ (2.5)
                                                                                                                 READ (2.5)
                                                                                                                                    READ (2.5)
                                                                                                                                                      READ (2,5)
                                                                                                                                                                                            READ (2,5)
                                                                                                                                                                                                                                   READ (2.5)
                                                                                                                                                                                                                                                      READ (2.5) PREQS
                                                                                                                                                                                                                                                                                                     READ (2,4)
                                                                                                                                                                                                                                                                                                                         READ (2+4)
                                                                                                                                                                                                                                                                                                                                                              READ (2,4)
                                                                                                                                                                                                                                                                                                                                                                        GO - TO
                  READ (2.5)
                                     双市かり (2,5)
                                                GO TO 200
                                                        READ (2,5)
                                                                                                        GO TO 200
                                                                                                                           GO TO 200
                                                                                                                                              GO TO 200
                                                                                                                                                                GO TO 200
                                                                                                                                                                                   GO TO 200
                                                                                                                                                                                                                                             GO TO 200
                                                                                                                                                                                                                                                                 GO TO (28,29,30,31), AFLAG
                                                                                                                                                                                                                                                                          GO TO
                                                                                                                                                                                                                                                                                  READ (2,4)
                                                                                                                                                                                                                                                                                             GO TO 200
                                                                                                                                                                                                                                                                                                               GO TO 200
                                                                                                                                                                                                                                                                                                                                   GO TO 200
                                                                                                                                                                                                                                                                                                                                                      60 TO
                                                                                                                                                                                                      200
                                                                                                                                                                                                                         200
                                                                                                                                                                                                                                                                          200
                                                                                                                                                                                                                                                                                                                                                                        200
                             200
                                                                  200
                                                                                                                                                                                                                                                                                                                                                     200
                                                                                                                                                                                                                                                                                                                                                                                          200
                                                                                                                                                                                                                                                                                                                                            .5.
,--4
                                                                                                                 RFACT
                                                                                                                                                       UM1(1)
                                                                                                                                                                                              PROOT
                                                                                                                                                                                                                                    PREGI
                                                                                                                                                                                                                                                                                   LFLAG
                                                                                                                                                                                                                                                                                                      MFLAG
 SP (2
                                                                                                                                                                                                                PRQOS
                                                                                                                                                                                                                                                                                                                         JFLAG
                                                                             PTI(1)
                                                                                                                                    EMACH
                                                                                                                                                                           Ξ
                                                                                                                                                                                                                                                                                                                                                                                  TITLE
                                      SHP(2
                                                                                                                                                                                                                                                                                                                                                               IFLAG
                   SP(1)
                                                          SHP (1)
                                                                                               TTI(1)
                                                                                                                                                                                                                                                                                                                                                                                                    TITL2
                                                                                                                                                                                                                                                                                                                                                                                                                56,57,58,59,60,61,62,63,
77,78,79,80,81),KCODE
                                                                                                                                                                                                                                                                                                                                                                           IMPT3049
                                                                                                                                                                                                                                                                                                                                                                                     INPT3048
                                                                                                                                                                                                                                                                                                                                                                 INPT3050
                                                                                                                                                                                                                                                                                                                                                                                             INP.T3047
                                                                                                                                                                                                                                                                                                                                                                                                       INPT3046
                                                                                                                                                                                                                                                                                                                                                                                                                INPT3044
INPT3045
                                                                                                                   INPT3075
                                INPT3084
                                         INP13083
                                                 INPT3082
                                                           [NPT308]
                                                                              IMPT3079
                                                                                                INPT3077
                                                                                                                                                          INPT3071
                                                                                                                                                                  NP13070
                                                                                                                                                                                      NPT3068
                                                                                                                                                                                               INPT3067
                                                                                                                                                                                                         111PT3066
                                                                                                                                                                                                                                      NPT3063
                                                                                                                                                                                                                                               NP13062
                                                                                                                                                                                                                                                                             NP.T3059
                                                                                                                                                                                                                                                                                      NPT3058
                                                                                                                                                                                                                                                                                              INPT3057
                                                                                                                                                                                                                                                                                                                  MPT3055
                                                                                                                                                                                                                                                                                                                            MP13054
                                                                                                                                                                                                                                                                                                                                     NPT3053
                                                                                                                                                                                                                                                                                                                                               WPT3052
                                                                                                                                                                                                                                                                                                                                                       NPT3051
                                                                    INPT3080
                                                                                         MPT3078
                                                                                                          NPT3076
                                                                                                                            NPT3074
                                                                                                                                                NPT3072
                                                                                                                                                                             NPT3069
                                                                                                                                                                                                                  NP 13065
                                                                                                                                                                                                                                                         NPT3061
                                                                                                                                                                                                                                                                   NPT3060
                                                                                                                                                                                                                                                                                                        NPT3056
                                                                                                                                      NPT3073
                                                                                                                                                                                                                            NPT3064
```

																	Villa Addi A								- 10 - 10 - 10										d. s		
α)	ω (0.70	ON	QN.	ON (Э (> 0	> C	n O	\ C	0	\circ	0	\circ	\circ	0	0	0	r-i	m-1, -				4 ~~	إسنع	r-4 1	- -1 (*	1 N	N	Cit	10	u ind	2	α	Va) H) (1) - (H)	8
(e)	(C) (30	F	ارد) ارد)	F- 1	m (- F	- ۲ ر د	3 6	- (4)	m 1	(U)	4 m	ሳ	- h-	- t	9	13	5	F-	$\frac{1}{2}$	6 €	- √. \	- -	(0)	E :		- t-	10	H 1	-1 €	- !		(C) (+- (1)	July	
2	zz	ŽZ	. 2	2	Z	2	zz	2 2	zz	· 2	· Z.	2.	zz	Z 2	Z 22	22	2	2	\boldsymbol{z}	2	2	Z_i :	2 2	z	2	2	22 2	22		Z	Z Z	Z	12	z_{z}	Z Z	Z 22°,	
							is in																												Š.		in .
				1. 1. 1.	si:												# : # :																				
				5 P 5																			P P														
				3			is Ç																4 (# # #												
																									- 8												
				0.000															•											Ş.							
												16. 18	•.							1.1																	
				1 000									.,,,																								
		ale Alteria		3											1994 2007 1997 1997								e R E		() ()												
																							9. 3.														
																				. j . j			di e K				지 설 경험 경험	지 경기 변 : -									
	_	_	_	_														~															(2)				
	• ×	Z Z	×	× ×						ili. Spari					<u>-</u>	• ×				L • K2		(1)		7 7			(2)		1	(2)		s≤. ♠ H.	# 1 * X		Ž	, 7,423	
	1	11													_¢ !i	33				11		*	. ·	∠ • •	- X-		× , , , ,	 	4	=2 • K	•) • 1 :			11	
	(T •		, ,	-											• -	-		• I •		1)		- ·					I 6			•	•	•	2 + I		()	· 1	
	1,1	•	•	2 \$ 2		(T)	, ((2)							<u>~</u>	-	ů.			(2)		I • I	•	7	• • •		2,1		+ • +	2.0	0) Y	AR		(T)	(2)	
	OE (<u> </u>) HO	OE O		OEM		O E E		- - -		(2)	·	1	χ. π	Ω π Δ	કું 🦠	AD1		AD1		×	•	- ×	~ ≻		~ ≻	7 ,	7) 2	٠,				ARS.	ARS	
	0	<u> </u>	-			0		·		Z ~		Z .				-				((_	_) (•			_			~ ~	<u> </u>	
	9		0 V	9	20	•	0		Ó	м У -	20		_ '	0	• :0	> •	^ C	• (0	•	0	•	\bigcirc .	• C	, é	O	•	0	• O	•	\circ	* C	> ,•	0	* √ (9 . 500 2.000 2.400	
10	5	AD (2	2	. ~	2	AD.	-	\bigcirc	0.7	ے 2		0	=N(2	- (- () - -)	> +-		10	-	10	C	(A C	- C	2	AD.		010		0		- 🗅	10		AD A	
09	111	LL C) II.	للااا	10	141	0	ш	\circ t	11 -	- O	u	N.	OL	ع تب	Dμ	3 C	نيا (\circ	Lil	0	Ú.	0	ے بد). U.	0	LU.	O^{-4}	10	Lil	OI	ے لد	ليا (0	ر لالا	ဝ ဗွဲ့	
131	42		43			77		4		\$ 0		47			4 20	07		50		ιυ Η		52		U.	54		rU rU		ם היים ה	5.7		ار ال	59		09	61	
																		8										48 8k		30			•				
															**																					21 1	
										;																		٠,٠									

(PT31313131313131313131313131313131313131	APTOIS APTOIS APTOIS	VPT314 VPT314 VPT314 VPT314	2010 10 10 10 10 10 10 10 10 10 10 10 10	VPT314 NPT315		NPTON STATE		NPTON NPTON NPTON SALGE PATON SALGE	INPTAINS INPAINS INPA	
I=1,K1)	•1=1•K1) •1=1•K2)	•1≂1•K1) •1=1•K2)	• [=1,3) • [≈2,3]							
D TO 20 EAD (2) D TO 20 EAD (2)	D TO 20 EAD (2) D TO 20 EAD (2)	5 TO 20 EAD (2.0 5 TO 20 EAD (2.0	5 TO 20 EAD (2) 5 TO 20 EAD (2)	EAD (2.5) R 0 TO 200	EAD (2,5) K O TO 200 EAD (2,5) S O TO 200	EAD (2.) 0 TO 20 EAD (2.)		0 TO 200 EAD (2.5) DELT 0 TO 200 EAD (2.5) VULI	NC	
63	65		a 6 9			74	75 75 77 77 77 77 77 77 77 77 77 77 77 7	78	80 200 // 20P	

*STORE WS UA *DUMP UA CD

INPT3

```
020
                                                                                                                                                                                                                                                                                                                                                                                             019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           029
                                                                                                                                 007
                                                                                                                                                                                                                                                                 013
                                                                                                                                                                                                                                                                                                                               016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   050
                                                                                                                                                                              600
                                                                                                                                                                                                 010
                                                                                                                                                                                                                                             012
                                                                                                                                                                                                                                                                                                                                                   017
                                                                                                                                                                                                                                                                                                                                                                        018
                                                                                                                                                                                                                                                                                                                                                                                                                                                             022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  027
                                                                                         0.05
                                                                                                              900
                                                                                                                                                        008
                                                                                                                                                                                                                       0.1.1
                                                                                                                                                                                                                                                                                                                                                                                                                                        021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      A0.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  LOA
                                                                                                                                                                                                                                                                                                                                                                         LOA
                                                                                                                                                                                                                                                                                                                                                                                                                    O.A
                                                                                                                                                                                                                                                                                                                                                                                                                                        LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                             AO.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      AO.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               A O
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                O.A
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     AO.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           AO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 LOA
                                                                                                                                                                                                 LOA
                                                                                                                                                                                                                                                                                                          LOA
                                                                                                                                                                                                                                                                                                                              LOA
                                                                                                                                                                                                                                                                                                                                                   LOA
                                                                                         LOA
                                                                                                              LOA
                                                                                                                                    LOA
                                                                                                                                                        LOA
                                                                                                                                                                                                                       LOA
                                                                                                                                                                                                                                             LOA
                                                                                                                                                                                                                                                                   LOA
                                                                                                                                                                                                                                                                                      407
                                                                                                                                                                                                                                                                                                                                                                                             COMMON WU2T(10), BD2T(10), W2T(10), REAT(10), UH(10), VUIH(10), AD1H(10)LOA
                                                                                                                                                                             LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       310), STRB(10), STRT(10), COE(2,2,10), CLEAR(2,10), ARS(2,10), TCRS(2,10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                        2SUMHS(2),PREQS,PREQT,IFLAG,CASE1,CASE2,JFLAG,KFLAG,MFLAG,LFLAG,L,
                                                                                                                                  ZETTTM.UMA(2), UCO.UCOM.RET(2).RES(2).PRST(2).PRTT(2).UMS.SUMH!(2).
                                                                                                                                                                                                                                                                                                                                                                                                                                                             3CS(10),UC(10),RMF(10),AC1(10),AC2(10),AC1H(10),AC2H(10),AC1T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     2STRL(2),TUM1,TPT1,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                     4PT0(10), AN1(10), H1(10), AN2(10), H2(10), UT(10), VULT(10), AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                         ZWUZH(10),8D2H(10),WZH(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                       COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRIOL
                                                                                                                                                                                                                                                                                                                                3RM(10), TT1(10), TT2(10), PRT(10), PRS(10), PRN(10), PT1(10), PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                     1, VIH(10), WUIH(10), BD1H(10), WIH(10), VU2H(10), AD2H(10), V2H(10),
                                                                                                                                                                                                                                                                                       [V1(10);VU1(10);VX1(10);W1(10);WU1(10);V2(10);VU2(10);VX2(10);
                                                                                                                                                                                                                                                                                                          2W2(10), WU2(10), BD1(10), AD2(10), BD2(10); ETS(10); ETT(10); E(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                           COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2), COEM(2), N(2), DHO(2), SP(2), PRSTM(2), PRTTM(2), ETST, EITI, EISIM;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            4, SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                         5V1T(10), WU1T(10), BD1T(10), W1T(10), VU2T(10), AD2T(10), V21(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                  AND LAMDA
                                                                                                                                                                                                                                                                 COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TWANI, PMANI,
                                                                                                                                                                                                    SETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         DHS(I)=UM1(L)**2*Y(L,I)**2/(32,174*778,16*PAS(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 [PT1T(10),PT1H(10),TITL1(20),TITL2(20),TITL3(20),
                                                STAGE LOADING, SPEED
                                                                                                                                                                                                                                               ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    PAO=UMI(L) **2/(32.174*778.16*DHO(L))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PAS(I)=Y(L,I)**2*PAS(I)/X(L,I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                DHO(L)=550.*SHP(L)/(778.16*W)

포
                                                                                                                                                                                  4 PROOS, PROOT, PRSMM, PRIMM,
                                                    CALCULATES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                [F (I-1) 40,40,100
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (1-1) 20,20,30
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PAS(I)=PAO*SUX
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     SUX=SUX+X(L,I)
              SUBROUTINE LOA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          DO 100 I=1,K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                DO 10 I=1,K
                                                     SUBROUTINE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            SUX=0.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (一)ハーソ
FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      30
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         0.4
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        0
```

100 UM(I)=Y(L,I)*UM1(L)

RETURN
END

// DUP

*STORE WS UA LOA
*DUMP UA CD LOA

and the complete of the complete control of the con

LOA 044 LOA 045 LOA 046

```
CALC1029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC1030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC1036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC1042
                                                                                                        CALC1005
                                                                                                                                                                                            CALC1008
                                                                                                                                                                                                                        CALC1009
                                                                                                                                                                                                                                                                                                                                                                        CALC1014
                                                                                                                                                                                                                                                                                                                                                                                                    CALC1015
                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC1016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC1018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                COMMON WUZT(10), BDZT(10), WZT(10), REAT(10), UH(10), VUIH(10), ADIH(10)CALCI019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC1020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC1022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC1023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC1024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC1025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC1026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC1027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)CALC1028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC1031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC1032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC1033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC1034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC1035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC1038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC1039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC1040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC1041
                                                                              CALC1004
                                                                                                                                                                                                                                                        CALC1010
                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC1017
                                                                                                                                      CALC1006
                                                                                                                                                                                                                                                                                    CALC1011
                                                                                                                                                                                                                                                                                                              CALC1012
                                                                                                                                                                                                                                                                                                                                            CALC1013
                                                                                                                                                               CALCIDO7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC1021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC103
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       3CS(10); UC(10); RMF(10); AC1(10); AC2(10); AC1H(10); AC2H(10); AC1T(10);
                                                                                                                                                                                            SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                               ETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 2STRL(2),TUM1,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           2WU2H(10),BD2H(10),W2H(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                               SUBROUTINE CALCULATES VELOCITY PARAMETERS AND MEAN BLADE VELOCITIES
                                                                                                                                                                                                                                                                                COMMON X(2,10), Y(2,10), REA(2,10), Z(2,10), ADL(2,10), PRSOL, PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                             4PTG(10), AN1(10), H1(10), AN2(10), H2(10), UT(10), VU1T(10), AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                 3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   1.VIH(10), WU1H(10), BD1H(10), W1H(10), VU2H(10), AD2H(10), V2H(10),
                                                                                                                                                                                                                                                                                                                                                                        1V1(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VU2(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                                                                                     2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             4, SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                    1COEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRTTM(2) .ETST.ETTT.ETSTM:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5VII(10), WULT(10), BDIT(10), WLT(10), VU2T(10), ADZT(10), V2T(10)
                                                                                                            COMMON IM, ID, IY, R, GAM, CP, VIS, SHP (2), W, TTI (2), PTI (2), UM1 (2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   5P2T(10), GOT(10), VEP(10), DVU(10), VX1T(10), VX2T(10), VX1H(10)
                                                                                                                                                                                                                                                                                                                                            COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, THANI, PMANI,
                                                                                                                                                                                                                                                        ETSMM, ETTMM, PTME (2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1PT1T(10), PT1H(10), TITL1(20), TITL2(20), TITE3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      BRANCH
                                                                                                                                                                                                                                                                                                                   ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREA!
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CONTROLS VELOCITY TRIANGLE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALCULATION OF VELOCITY PARAMETERS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  10.5*COT(1)**2*(1.-1)*2*2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         COT(I) = COS(AR1)/SIN(AR1)
                                                                                                                                                                                                                                   4 PROOS . PROOT . PRSMM . PRTMM .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               AR1=AD1(L,1)/57.296
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     DVU(I) = UM(I) /PAS(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALL DATSW (1.JSW)
SUBROUTINE CALCI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                DO 100 I=1+K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         DATA SWITCH 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  5,RT(10)

u \ 
u \ 
u

                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          \cup \cup
```

```
CALC1044
CALC1045
                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC1073
                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC1074
                                                                    CALC1049
                                                                                                                                                                                                                                                                                                                                                                        CALC1069
                                                                                                                                                                                                                                                                                                                                                                                       CALC1070
                                                                                                                                                                                                                                                                                                                                                                                                                  CALC1072
                          CALC1046
                                     CALC1047
                                                      CALC1048
                                                                                   CALC1050
                                                                                                                                                             CALC1055
                                                                                                                                                                                                        CALC1058
                                                                                                                                                                                                                      CALC1059
                                                                                                                                                                                                                                    CALC1060
                                                                                                                                                                                                                                                                                                             CALC1065
                                                                                                                                                                                                                                                                                                                           CALC1066
                                                                                                                                                                                                                                                                                                                                                         CALC1068
                                                                                                                                                                                                                                                                                                                                                                                                    CALC1071
                                                                                                 CALC1051
                                                                                                                 CALC1052
                                                                                                                                              CALC1054
                                                                                                                                                                                                                                                                                CALC1063
                                                                                                                                                                                                                                                                                               CALC1064
                                                                                                                                CALC105.
                                                                                                                                                                                          CALC105
                                                                                                                                                                                                                                                    CALC106.
                                                                                                                                                                                                                                                                  CALC106
                                                                                                                                                                                                                                                                                                                                           CALC106
                                                                                                                                                                           CALCIOS
                                                                                                                                                                            START CALCULATION OF MEAN BLADE VELOCITIES
                                                                                                                                                 VEP(I)=(-SQRT(1.-4.*F*G)-1.)/(2.*F
                                                                                                                   VEP(I)=(SORT(1.-4.*F*G)-1.)/(2.*F)
  G=-((1.-REA(L,I))*PAS(I)+0.5)
                                                                        VELOCITY TRIANGLE TYPE BRANCH
                                                                                                                                                                                                                                                                    BR1=ATAN (WU1(1)/VX1(I))
                                                                                                                                                                                                                                                                                                                                             AR2=ATAN (VU2(I)/VX2(I)
                                                                                                                                                                                                                                                                                                                                                                                                        BR2=ATAN (WU2(1)/VX2(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                    W2(I)=VX2(I)/COS (BR2)
                                                                                                                                                                                                                                                                                                 W1(I)=VX1(I)/COS (BR1)
                                                                                                                                                                                                                                                                                                                                                                          V2(I)=VX2(I)/COS (AR2)
                                                                                                                                                                                                                                         V1(I)=VU1(I)/SIN (ARI
                                                                                                                                                                                                                                                                                                                VU2(I)=VU1(I)-DVU(I)
                                                                                                                                                                                                            VU1(I)=VEP(I)*DVU(I)
                                                                                                                                                                                                                         VX1(I)=VU1(I)*COT(I)
                                                                                                                                                                                                                                                                                                                               VX2(1)=VX1(1)*2(L*1)
                                                                                                                                                                                                                                                                                                                                                                                         WU2(1)=VU2(1)-UM(1)
                                                                                                                                                                                                                                                      WUI(I)=VUI(I)-UM(I)
                                                                                                                                                                                                                                                                                   BD1(1)=BR1#57.296
                                                                                                                                                                                                                                                                                                                                                             AD2(1)=AR2*57.296
                                                                                                                                                                                                                                                                                                                                                                                                                      BD2(1)=BR2*57.296
                                                                                                       GO TO (32,31), JSW
                            20 VEP(I)=-G
                  0-
                                                                                                                                    GO TO 35
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  END
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // DUP
*STORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          *DUMP
                                                                                                                                                                                                                                                                                                                                                                                                                                      1:00
                                                                                                        30
                                                                                                                                                                                                            ω
ω
                                                                                                                                                    35
```

```
CALC 2016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC2020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC2023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC2024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       310), STRB(10), STRT(10), COE(2,2,10), CLEAR(2,10), ARS(2,10), TCRS(2,10) CALC2030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC2036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC2038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC2039
                   CALC2002
                                             CALCZ003
                                                                           CALC2004
                                                                                                                                                                                                                      CALC20.09
                                                                                                                                                                                                                                                                                                                                        CALCZ013
                                                                                                                                                                                                                                                                                                                                                                  CALC2014
                                                                                                                                                                                                                                                                                                                                                                                              CALC2015
                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC2017
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC2018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC2019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            0) CALC2021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC2022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC2029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC2031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC2032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC2035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC2037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CACCOAD
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC2041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALCZO4Ż
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC2043
                                                                                                                                                                                                                                                                                                          CALC2012
                                                                                                                                                                                                                                                                              CALCZOLI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC2034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC2027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC203
                                                                                                                                                                                                                                                CALCZOT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALCZOZ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC202
                                                                                                                                                                                                                                            3SUNHS(2), PREOS, PREOT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, WFLAS, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         D=2.*COT(I) **2*VEP(I) **2+(VEP(I) -PAS(I)) **2+(VEP(I) -PAS(I) -1.) **2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COMMON WUZT(10), BDZT(10), WZT(10), REAT(10), UH(10), VUIH(10), ADIH(1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2STRL(2),TUMI,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                    2ETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2)
                                                                                                                                                                                                                                                                                                                                      COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4PTO(10),AN1(10),H1(10),AN2(10),H2(10);UT(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      ZWUZH(10), BDZH(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1,V1H(10),WU1H(10),BD1H(10),W1H(10),VU2H(10),AD2H(10),V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                          ZW2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                            IVI(10), VUI(10), VXI(10), WI(10), WUI(10) FVZ(10), VVZ(10), VXZ(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                        1COEM(2), M(2), DHO(2), SP(2), PRSTM(2), PRITM(2), ETST, ETTT, ETSTM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   4.SECON(2:10); ARCON(2:3); SOLID(2:10); DELTA(2); OSF(2); OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                5VIT(10); WULT(10); BDLT(10); WLT(10); VU2T(10); ADZT(10); VZT(10)
                                                                                                                                                               COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                             STAGE
                                                                                                                                                                                                                                                                                                                                                                                              COMMON UM(10), PAS(10), DHS(10), SMACH, INPAR, IMANI, PNANI,
                                                                                                                                                                                                                                                                                                            SETSMM, ETTMM, PTME (2), AREAE, TECE, PECE, RFACT, IPAGE, ENACH
                                               SUBROUTINE DETERMINES STAGE LOSSES, MANIFOLD LOSSES.
PRESSURES, TEMPERATURES, ANNULUS AREAS, SLADE HEIGHTS AND
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  1PT1T(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                                                                                                                     1ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREA!
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        TIP RADIUS OPTION
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CONTROLS INPUT OF VULIN
SUBROUTINE CALCZ (KJ, VULIN)
                                                                                                                                                                                                                                                                                     4 PROOS PROOT , PRSMW, PRTMM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CONTROLS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CON3=GAM/(GAM+1.)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      DATSW(2,JSW)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                DATSW(3.9KSW)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    DO 145 I=1,J
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                DATA SWITCH 2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          SWITCH 3
                                                                                                            EFFICIENCYS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ( T) N=C
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 DATA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         0 0 0 0
```

```
CALC2044
CALC2045
                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC2074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2ALC2076
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC2077
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC2078
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC2079
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALCZORI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC2082
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALCZÓ83
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC2084
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC2086
                                                                                                                                               TALCE054
                                                                                                                                                             CALC2055
                                                                                                                                                                                                         TALC2058
                                                                                                                                                                                                                        2ALC2059
                                                                                                                                                                                                                                       TALC2000
                                                                                                                                                                                                                                                                                                                                                          CALC2068
                                                                                                                                                                                                                                                                                                                                                                          CALC2069
                                                                                                                                                                                                                                                                                                                                                                                        CALCZO70
                                                                                                                                                                                                                                                                                                                                                                                                                     CALC2072
                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC2073
                                                                                                                                                                                                                                                                                                                                                                                                                                                               270201AD
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC2680
                                         CALC2047
                                                                                                                                CALC2053
                                                                                                                                                                             34LC2656
                                                                                                                                                                                          741.02057
                                                                                                                                                                                                                                                                                  14LC2063
                                                                                                                                                                                                                                                                                                 ALC2064
                                                                                                                                                                                                                                                                                                               CALC2065
                                                                                                                                                                                                                                                                                                                              CALCZG66
                          CALCZÓG6
                                                        CALCZ048
                                                                                     1ALC2050
                                                                                                   SALCZOSI
                                                                                                                  CALC27552
                                                                                                                                                                                                                                                      CALCZÓ67
                                                                                                                                                                                                                                                                                                                                                                                                      CALCZO71
                                                                                                                                                                                                                                                                    Ö
                                                                                                                                                                                                                                                      SUTV
                                                                                                                                                                                                                                                                    ALC2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     AREAI=W/PTI(1)*SORT(R*TTI(1)/GAM/32.174)*EMACH**(GAM+1.)/(2.*
                                                                                                                                                                                                                                                                                                                                                                                                        STL=SLOSS /(2.*32.174*778.16*COT(I)*RE**0.2)*(FST*C*DVU(I)**2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PTME(1) = PT1'(1) / (1.+COEM(1) * (1.-1.7FMACH**CON3))
                                                                                                                                                                                                                                                                                                                                                            RLOSS=COF(L,2,1)*(0.802+5.86*CLEAR(L,1)/H2(I))
                                                                                                                                                                                                                                                                                                                                                                            SLOSS=COE(L3191)*(0.80245.66*CLEAB(L31)/H2(1))
                                                                                                                                    C=(1.+2.**COT(1)**2)*VEP(1)**2+(VUO/DVU(1))**2
                                                                                                                                                                                                                                                                                                                                                                                                                     A=(FST*SLOSS*C+FRO*RLOSS*D)/(RE**O.2*COT(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               INLET MANIFOLD CONDITIONS DETERMINED
                                                                                                                                                                                                                                                                       RW(1)=30.*(IM(I)X(3.14159*SP(L))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              FMACH=1.+(GAM-1.)/2.*BMACH**2
                                                                                                                                                                                                                                                                                                                                                                                                                                        EII(1)=PAS(1)/(PAS(1)+0.5*A)
                                                                                                                                                                                                              IF (PAS(1)-0.5) 80.80.90
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           PMANT = PTI(1) / FMACH* * CON3
                                                                                                                                                                                                                                                                                                                                                                                                                                                       IF (I-1) 100,100,110
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              TMANI=TTI(1) ZFMACH
                                                                                                                                                                                                                             FST#2.*(1.-PAS(1))
                                                                                                                                                                                               F (1-1) 90,90,70
                            IF (I-I) 65,55,50
IF (I-I) 40,40,50
    10 (20,201-)3W
(L-1) (25,25,21
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    J. (201.101) (105)
                                                                                                                                                                    GC - TO - (70 + 56) + JSE
                                                                                                                                                                                  1F (L-1) 57457+70
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1(GAM-1.))/BMACH
                                                                                                                                                                                                                                                                                      REHW/(RM(I)*VIS)
                                                                                                                                                                                                                                                                                                                    SLOSS=COE(L:1:1)
                                                                                                                                                                                                                                                                                                                                   RLOSS=COE(L,2,1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       PTO(T)=FTME(L)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      TTI(1)=TTI(L)
                                                                                                                         VUO=VU2(1-1)
                                                                                                                                                                                                                                                                                                                                                                                              HSAVE=H2(1)
                                                                                                                                                                                                                                                                                                       HSAVE=0.0
                                                              VUO=VU11N
                                                                                                                                                                                                                                                                                                                                                 26 01 09
                                                                                                          60 TO 55
                                                                                                                                                                                                                                             60. TO 95
                                                                              GO TO 58
                                                                                            VUO#0.
                                                                                                                                                                                                                                                           FSTELL
                                                                                                                                                      FRO=2.
      09
H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     100
                  202
                                              55
                                                                                                                                                                                    Q
(II)
                                                                                                                                                                                                                              0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 101
                                                                                                                                                                                               5
                                                                                                                                                                                                               70
                                                                                                                                                                                                                                                                        ц
С
                                                                                                                                       50
```

```
CALC2088
CALC2089
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC2128
                                                                                                                                                                                                                                                      CALC2104
                                                                                                                                                                                                                                                                                       CALC2106
                                                          CALC2092
                                                                                                                                                                       CALC2099
                                                                                                                                                                                                                                                                       CALC2105
                            CALC2090
                                           CALCZOSI
                                                                           CALC2093
                                                                                          CALC2094
                                                                                                         CALC2095
                                                                                                                                                                                         CALC2100
                                                                                                                                                                                                                                                                                                       CALC2107
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC212
                                                                                                                        CALC209
                                                                                                                                                       CALCZOS
                                                                                                                                                                                                       CALC210
                                                                                                                                                                                                                        CALC210
                                                                                                                                                                                                                                       CALC210
                                                                                                                                                                                                                                                                                                                                       CALCZIO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC212
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALCZ12
                                                                                                                                                                                                                                                                                                                        CALC210
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC211
                                                                                                                                                                                                                                                                                                                                                                       CALC211
                                                                                                                                                                                                                                                                                                                                                                                                     CALC211
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC211
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC212
                                                                                                                                                                                                                                                                                                                                                       CALC211
                                                                                                                                                                                                                                                                                                                                                                                     CALCZII
                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC21.1
                                                                                                                                                                                                                                                                                                                                                                                                                     CALC211
                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC211
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC21
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALCZI
                                                                                                                                         20170
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 SO17.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STAGE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 \frac{1}{2}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     THE FIRST
ROTOR AND
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 THE FIRST IS THE AVERAGE
                                                                                                           STAGE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               AND DOWNSTREAM ROIGES
                                                                                                                                                                                                                                                                                                                         ETS(1) = DHS(1) / (CP*TT1(1) * (1 • - (1 • / PRS(1)) * * (1 • / CON3))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    NOZZLE MEAN RADIUS FOR THE FIRST STÁGE IS THAT OF ROTOR PLUS THE DIFFERENCE RETWERN THE FIRST STAGE
                                                                                                           RATIO CALCULATED FROM EFFICIENCY AND
                                                                                                                                                         PRT(1)=1./(1.-DHS(1)/(ETT(1)*CP*TT1(1)) **CON3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   BUT
                                                                                                                                                                                                                                                                          P1(1)=P11(1)*(T1(1)/TT1(1))**CGN3
                                                                                                                                                                                                                                                                                        P2(I) +P12(I)*(T2(I)/IT2(I))**CON3
                                                                                                                                                                                                                         PRN(1)=(1.-STL/(CP*11(1)))**CON3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   H1(1)=AN1(1)/(2.*3.14159*RMA(1))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   H1(2)=AN1(2)/(2.*3.14159*RMA(2))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   RADIUS OF ALL MOZZLESS
RADII OF THE URSTREAM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      SECOND, STAGE NOZZEE HEAN RADII
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      RMA(1)=(3.*RMF(1)-RMF(2)1/2.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    RMA(I)=(RMF(I)+RMF(I-1))/2
                                                                                                                                                                                                           T2(I)=TT2(I)-V2(I)**2/CONI
                                                                                                                                                                                                                                                                                                                                                                         AN1(I)=144.*W/(R01*VX1(I))
                                                                                                                                                                                           T1(1)=TT1(1)-V1(1)**2/CON1
                                                                                                                                                                                                                                                                                                                                                                                        AN2(I)=144.*4/(R02*VX2(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    RMA(2) = (RMF(1)+RMF(2))/2.
                                                                                                                                                                            CON1=2.*32.174*778.16*CP
                                                                                                                                                                                                                                                                                                                                          RO1=144.*P1(1)/(R*T1(1))
                                                                                                                                                                                                                                                                                                                                                         RG2=144. %P2(1)/(R*T2(1))
                                                               TT2(1)=TT1(1)-DHS(1)/CP
                                                                                                                                                                                                                                           PT1(1)=PT0(1)*PRN(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                        IF WINGS 1223 1255 126
                                                                                                                                                                                                                                                          PT2(1)=PT0(1)/PRT(I)
                                                                                                                                                                                                                                                                                                           PRS(1) = PTO(1) / P2(1)
                                                                               RMF(1)=12.*RM(1)
                                 TT1(1)=TT2(1-1)
PT0(1)=PT2(1-1)
                                                                                                                                                                                                                                                                                                                                                                                                                         PMA(1)=RMF(1)
    PTO(1)=PTI(2)
GO TO 120
                                                                                                               PRESSURE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      MEAN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       GO T0127
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      出出
                                                                                                                TOTAL
                                                                                                                               MORK
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      126
                                                                120
                                                                                                                                                                                                                                                                                                                                                                                                                                                        124
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        in
    102
                                   110
                                                                                                                              υÜ
                                                                                                  \mathbf{C}^{\prime}\mathbf{C}
```

```
CALC2134
CALC21334
CALC2135
CALC2135
CALC2135
CALC2135
                                                                            CALC2142
CALC2140
                                                             CALC2140
                                                                     CALC2141
                                                                                            CALC2194
              124 H1 (1) #712(1) / [3,43,14159*P4(1))
                                                       Y(L,1) *(21(1) *H2(1)/2.)/RMF(L)
                                                                        1F (LFLXS-1) 200,200,190
                                                                                                              3770
                                                                                                               35
                                                                               (C) BONATORA JOI
                                                               COLINE
                                                                                       200 RETURN
                                                64
. 15
12
                                                                                                      *ST 7.8
*ST 7.8
                                                                 5547
                                                ()
Vi
```

```
CALC9029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC9033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC9035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC9036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC9038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC9039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC9040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC9026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)CALC9028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC9030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC9032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC9034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC9037
                                                                                                                                                                                                                                                                CALC9010
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC9020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC9022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC9024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC9041
                                              CALC9003
                                                                           CALC9004
                                                                                                                                      CALC9006
                                                                                                                                                                                                 CALC9008
                                                                                                                                                                                                                               CALC9009
                                                                                                                                                                                                                                                                                                                                                     CALC9013
                                                                                                                                                                                                                                                                                                                                                                                                                    CALC9015
                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC9016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC9017
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          COMMON WUZT(10), BDZT(10), WZT(10), REAT(10), UH(10), VUIH(10), ADIH(10)CALC9019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC9023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC9025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC9027
                CALC9002
                                                                                                           CALC9005
                                                                                                                                                                      CALCGOO7
                                                                                                                                                                                                                                                                                            CALC9011
                                                                                                                                                                                                                                                                                                                         CALC9012
                                                                                                                                                                                                                                                                                                                                                                                  CALC9014
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC9021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC9031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                               SUMHS(2), PREGS, PREGT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                      ETITM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    2STRL(2),TUM1,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 AREAF=W/PTME(2) * SQRT(R*TT2(J)/GAM/32.174) *FMACH**(GAM+1.)/(2.*
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 4,PT0(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ZWUZH(10), BDZH(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                               3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10),
                                                                                                                                                                                                                                                                                            COMMON X/(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRIOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1.VIH(10), WU1H(10), BD1H(10), W1H(10), VU2H(10), AD2H(10), V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                    2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                      1V1(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VU2(10), VX2(10);
                                                                                                                                          ICOEM(2) .N(2) .DHO(2) .SP(2) .FRSTM(2) .PRT1M(2) .E1S1 .E111 .E151M.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 4.SECON(2,10),ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                            COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5V1T(10) , WUIT(10) , BD1T(10) , WIT(10) , VUZT(10) , AD2T(10) , VZT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            SP2T(10),COT(10),VEP(10),DVU(10),VXIT(10),VXZT(10),VXIH(10)
                                                 SUBROUTINE DETERMINES EXHAUST COLLECTOR LOSSES AND CONDITIONS
                                                                                                                                                                                                                                                                                                                                                         COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                ETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1PT11(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         PIME(2)=PT2(J)/(1.+COEM(2)*(1.-1./FMACH**CON3))
                                                                                                                                                                                                                                                                                                                               ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               FMACH=1.+(GAM-1.)/2.*EMACH**2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         PECE=PIME(2)/FMACH**CON3
                                                                                                                                                                                                                                      4 PRGOS , PROOT , PRSMM , PRTMM ,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  GO TO (150,129) , LFLAG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CONSTGAM/(GAM-1.)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   GO TO (200,150),L
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        FECE-TT2(J)ZFMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             1(GAM-1.))/EMACH
SUBROUTINE CALCS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      RETURN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   150
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         200
```

and //

*STORE WS UA CALC9
*DUMP UA CD CALC9

```
CAL C3029.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC3030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC3034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         IALC3035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      TALC3036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC3038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC3039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC3040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CAL C3042
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CAL C3026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),ICRS(2,10)CALC3028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC3031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC3037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC3043
                                                                                                                                                                                       CALC3008
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC3018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 COMMON WUZT(10), BD2T(10), WZT(10), REAT(10), UH(10), VUIH(10), ADIH(10)CALC3019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ALC3024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    LALC3025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC3032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC3041
                CALC3002
                                            CALC3003
                                                                          CALC3004
                                                                                                                                  CALC3006
                                                                                                                                                          CALC3007
                                                                                                                                                                                                                    CALC3009
                                                                                                                                                                                                                                                CALC3010
                                                                                                                                                                                                                                                                                                                                                          CALC3014
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC3020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC3027
                                                                                                     CALCBOOS
                                                                                                                                                                                                                                                                                                     CALC3012
                                                                                                                                                                                                                                                                                                                                CALC3013
                                                                                                                                                                                                                                                                                                                                                                                                                                             CALCBOI7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC3021
                                                                                                                                                                                                                                                                          CALC301.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC302
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC303
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC302
                                                                                                                                                                                                                                                                                                                                                                                        CALC301
                                                                                                                                                                                                                                                                                                                                                                                                                  CALC301
                                                                                                                                                                                       3SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),121(10),
                                                                                                                                                          ZETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRSI(2), PRTI(2), UMS, SUMHI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         2STRL(2), TUM1, TPT1, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), SIRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         2WU2H(10), BD2H(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                  3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PI1(10),PI2(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                             4PT0(10),AN1(10),H1(10),AN2(10),H2(10),UI(10),VUIL(10),AD1F(10);
                                                                                                                                                                                                                                                                        COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRIOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                1.VIH(10), WUIH(10), BD1H(10), WIH(10), VUZH(10), ADZH(10), VZH(10),
                                                                                                                                                                                                                                                                                                                                                                                      2W2(10),WU2(10),BD1(10),AD2(10),BD2(10),E1S(10),E11(10);E(10);
                                                                                                                                                                                                                                                                                                                                                          1V1(10),VU1(10),VX1(10),W1(10),WU1(10),V2(10),VU2(10),VX2(10),
                                                                                                                                  1COEM(2) .N(2) .DHO(2) .SP(2) .PRSIM(2) .PRITM(2) .ETST .ETTT .ETSTM .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 4,SECON(2,10),ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          5V1T(10); WU1T(10); BD1T(10); W1T(10); VU2T(10); AD2T(10); V2T(10)
                                                                                                          COMMON TM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5P2T(10) • COT(10) • VEP(10) • DVU(10) • VX1T(10) • VX2T(10) • VX1H(10)
                                                                                                                                                                                                                                                                                                                                  COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                5ETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PIII(10), PTIH(10), TITL1(20), TITL2(20), TITL3(20),
                                                 OVERALL TURBINE PERFORMANCE
                                                                                                                                                                                                                                                                                                        ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            PERFORMANCE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               SUMHS(L)=SUMHS(L)+DHS(I)/ETT(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                SUMHS(L)=SUMHS(L)+DHS(I)/ETS(I)
                                                                                                                                                                                                                         4 PROOS , PROOT , PRSMM , PRTMM ,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (I-N(L)) 140,130,130
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OVERALL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PRST(L)=PRST(L)*PRS(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         PRST(L)=PRST(L)*PRT(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              PRTT(L)=PRTT(L)*PRT(I)
                                                    SUBROUTINE DETERMINES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CON4 = (GAM-1.) / GAM
SUBROUTINE CALC3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALCULATION OF
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  DO 200 I=1,K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              GO TO 150
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     K=N(L)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 150
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          130
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             140
```

UU

```
CALC3083
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC3085
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC3086
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC3073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC3075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC3076
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC3079
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC3082
            CALC3045
                                                                                CALC3049
                                                                                                 CALC3050
                                                                                                                                                    CALC3053
                                                                                                                                                                     CALC3054
                                                                                                                                                                                      CALC3055
                                                                                                                                                                                                       CALC3056
                                                                                                                                                                                                                      CALC3057
                                                                                                                                                                                                                                        CALC3058
                                                                                                                                                                                                                                                         CALC3059
                                                                                                                                                                                                                                                                                                                             CALC3063
                                                                                                                                                                                                                                                                                                                                                               CALC3065
                                                                                                                                                                                                                                                                                                                                                                                CALC3066
                                                                                                                                                                                                                                                                                                                                                                                                 CALC3067
                                                                                                                                                                                                                                                                                                                                                                                                                  CALC3068
                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC3069
                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC3070
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC3072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC3074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CAL C3073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC3080
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC3081
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC3084
                              CALC3046
                                            CALC3047
                                                               CALC3048
                                                                                                                                  CALC3052
                                                                                                                                                                                                                                                                          CAL C3060
                                                                                                                                                                                                                                                                                                            CALC3062
                                                                                                                                                                                                                                                                                                                                             CALC3064
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CAL C3071
                                                                                                                 CALC3051
                                                                                                                                                                                                                                                                                           CALC3061
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC3087
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC307
SUMHT(L)=SUMHT(L)+DHS(I)/ETT(I)
CS(I)=SQRT (2.*32.174*DHS(I)*778.16/ETS(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 UCOTM=UMA(L)/SQRI(2.*32.174*778.16*DHITM)
                                                                                                                                                                                                                                                                                          UCTOL=UMA(1)/SQRT(2.*32.174*778.16*DHTOL
                                                                                                                                                                                                                                                                             JCSOL=UMA(1)/SQRT(2.*32.174*778.16*DHSOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    DHITM=CP*TTI(L)*(1.-(1./PRTTM(L))**CON4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      DHISM#CP*TTI(L)*(1.-(1/PRSTM(L))**CON4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              JCOT=UMA(L)/SQRT(2.*32.174*778.16*DHIT)
                                                                                                                                                                                                                                                                                                                                                                                                                                                     DHIT=CP*TTI(L)*(1.-(1./PRTT(L))**CON4)
                                                                                                                                                                                                                                                                                                                                                                                                                                      DHIS=CP*TTI(L)*(1.-(1./PRST(L))**CON4)
                                                                                                                                                                                                          DHSOL=CP*TTI(1)*(1.-(1./PRSOL)**CON4)
                                                                                                                                                                                                                           DHTOL = CP*TTI(1)*(1.-(1./PRTOL)**CON4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                COSM=2.*32.174*778.16*DHISM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            COS=2.*32.174*778.16*DHIS
                                                                                                                                                                                                                                                                                                                                                                                                     PRTTM(2)=PTI(2)/PTME(2)
                                                                                                                                      PRTTM(1)=PTI(1)/PT2(K)
                                                                                                                                                         GO TO (215,230), LFLAG
                                                                                                                     PRSTM(1)=PTI(1)/P2(K)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  RET(L)=SUMHT(L)/DHIT
                                                                                                                                                                                                                                                                                                                                                                                                                    PRSTM(2)=PTI(2)/PECE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ES(L)=SUMHS(L)/DHIS
                                                                                                                                                                                          PRTOL=PTI(1)/PTME(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ETSTM=DHO(L)/DHISM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             MITHUZ(1) OHOHMITHE
                                                                                                                                                                                                                                             ETSOL = DHO(1) / DHSOL
                                                                                                                                                                                                                                                             ETTOL=DHO(1)/DHTOL
                                                                                                                                                                          PRSOL=PTI(1)/PECE
                                                                                                   GO TO (210,220),L
                                 UC(I)=UM(I)/CS(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ETST=DHO(L)/DHIS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ETTT=DHO(L)/DHIT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  UCOMEDIMA (L) / GOM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 COM=SORT (COSM)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                JC0=UMA(L)/C0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CO=SQRT (COS)
                                                                                     JMA(L)=JMS/DV
                                                   UMS=UMS+UM(I)
                                                                                                                                                                                                                                                                                                               PRSMM=PRSOL
                                                                                                                                                                                                                                                                                                                                 PRTMM-PRTOL
                                                                                                                                                                                                                                                                                                                                                   ETSMM-ETSOL
                                                                                                                                                                                                                                                                                                                                                                   ETTMW=ETTOL
                                                                                                                                                                                                                                                                                                                                                                                    50 TO 230
                                                                      DV=K
                                                    200
                                                                                                                        210
                                                                                                                                                                            215
                                                                                                                                                                                                                                                                                                                                                                                                       220
                                                                                                                                                                                                                                                                                                                                                                                                                                        230
```

END // DUP

*DUMP

*STORE WS UA CALC3 UA CD CALCA

```
CALC4039
                                                    CALC4003
                                                                                                                  CALC4005
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC4019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          COMMON WUZT(10), BDZT(10), WZT(10), REAT(10), UH(10), VUIH(10), ADIH(10)/CALC4020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC4025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC4026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC4028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC4029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC4030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC4032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 TALC4033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC4034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC4035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC4036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC4038
                                                                                      CALC4004
                                                                                                                                                 CALC4005
                                                                                                                                                                                                                                           CALC4009
                                                                                                                                                                                                                                                                           CALC4010
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC4016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC4018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC4024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC4031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC4040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC4041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC4042
                        CALC4002
                                                                                                                                                                            CALC4007
                                                                                                                                                                                                             CALC4008
                                                                                                                                                                                                                                                                                                                                       CALC4012
                                                                                                                                                                                                                                                                                                                                                                       CALC4013
                                                                                                                                                                                                                                                                                                                                                                                                       CALC4014
                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC4015
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC4021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC4022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC4023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC4027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC4037
                                                                                                                                                                                                                                                                                                           CALC4011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC4017
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10);TCRS(2,10)
4,SECON(2,10),ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                                                                                                                                                           3SUMHS(2),PREOS,PREOT,IFLAG,CASE1,CASE2,JFLAG,KFLAG,MFLAG,LFLAG,L;
                                                                                                                                                                                                            2ETTTM.UMA(2), UCO, UCOM, RET (2), RES (2), PRSI (2), PRI 1 (2), UMS, SUMHI (2).
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      3CS(10); UC(10); RMF(10); AC1(10); AC2(10); AC1H(10); AC2H(10); AC1T(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            2STRL(2),TUM1,TPT1,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ZWUZH(10), BDZH(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                       COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),ADI(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               3RM(10), TT1(10), TT2(10), PRT(10), PRS(10), PRN(10), PT1(10), PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             4PTO(10), AN1(10), H1(10), AN2(10), H2(10), UT(10), VU1T(10), AD1T(10),
                                                    SUBROUTINE CALCULATES RADIAL VELOCITY DISTRIBUTION FOR FREE VORTEX
                                                                                                                                                                                                                                                                                                                                                                                                                                                               2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ELL(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          1. VIH(10), WUIH(10), BD1H(10), WIH(10), VUZH(10), AD2H(10), VZH(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                     1V1(10), VU1(10); VX1(10), W1(10); WU1(10); V2(10); VU2(10); VX2(10);
                                                                                                                                                                               1COEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRI IM(2) .EISI .EITI .EISIM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5VIT(10), WULT(10), BDLT(10), WLT(10), VUZT(10), ADZT(10), VZ!(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                       COMMON UM(1.0), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                                                           ETSMM, ETTMM, PIME (2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                PT1T(10), PT1H(10), T1TL1(20), T1TL2(20), T1TL3(20),
                                                                                                                                                                                                                                                                                                                                                                         ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               VUIT(I)=VUI(I)*RMA(I)/(RMA(I)+H1(I)/2.1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   UT(I)=(RM(I)+H2(I)/24.)*UM(I)/RM(I
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          BRIT=ATAN (WUIT(I)/VXIT(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               ARIT=ATAN (VUIT(I)/VX1T(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (BRIT)
                                                                                                                                                                                                                                                                               4-PRUDS . PRUDT . PRSMM . PRTMM .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            MU1T(1) = VU1T(1) + UT(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               AD1T(1)=57.296*AR1T
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          BD1T(I)=57.296*BR1T
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               NIS/(I)L(Name I)LIA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          W11(1)=VX11(1)/COS
SUBROUTINE CALCA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     VX1T(1)=VX1(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         DO 100 I=1 K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               ( ) N=X
                                                                                           BLADING
```

```
CALC4070
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC4076
                                                                                                                                                                                                                                                                                                                                                                                                CALC4065
                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC4058
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC4069
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC4074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC4075
             CALC4045
                                 CALC4046
                                                  CALC4047
                                                                      CALC4048
                                                                                         CALC4049
                                                                                                          CALC4050
                                                                                                                                              CALC4052
                                                                                                                                                                 CALC4053
                                                                                                                                                                                   CALC4054
                                                                                                                                                                                                     CALC4055
                                                                                                                                                                                                                         CALC4056
                                                                                                                                                                                                                                          CALC4057
                                                                                                                                                                                                                                                            CALC4058
                                                                                                                                                                                                                                                                                 CALC4059
                                                                                                                                                                                                                                                                                                   CALC4060
                                                                                                                                                                                                                                                                                                                       CALC4061
                                                                                                                                                                                                                                                                                                                                         CALC4062
                                                                                                                                                                                                                                                                                                                                                           CALC4063
                                                                                                                                                                                                                                                                                                                                                                              CALC4064
                                                                                                                                                                                                                                                                                                                                                                                                                 CALC4066
                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC4067
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC4071
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC4072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC4073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC4077
                                                                                                                             CALC4051
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     REAH(I)=1.-(VX]H(I)**2-VX2H(I)**2)/(2.*UH(I)*(VU]H(I)-VU2H(I)))
                                                                                                                                                                   REAT(I)=1.-(VX1T(I)**2-VX2T(I)**2)/(2.*UT(I)*(VU1T(I)-VU2T(I)))
                                                                                                                                                                                                                          VUJH(I)=VUJ(I)*RMA(I)/(RMA(I)-HJ(I)/2•)
VU2T(I)=VU2(I)*RM(I)/(RM(I)+H2(I)/24.)
                                                                                                                                                                                                                                                                                                                                                                                                  VU2H(I)=VU2(I)*RM(I)/(RM(I)-H2(I)/24.
                                                                                                                                                                                                          UH(I)=(RM(I)-H2(I)/24.)*UM(I)/RM(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           -(VUIH(I)+VU2H(I))/(2.*UH(I))
                                                                                                                                                                                        1-(VU1T(I)+VU2T(I))/(2.*UT(I))
                                                                                                                                                                                                                                                                  ARIH=ATAN (VUIH(I)/VXIH(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                         ARZH=ATAN (VU2H(I)/VX2H(I))
                                                                                                                                                                                                                                                                                                                                            BRIH=ATAN (WUIH(I)/VXIH(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                R2H=ATAN (WU2H(I)/VX2H(I))
                                       AR2T=ATAN (VU2T((1)/VX2T(I))
                                                                                                               BR2T=ATAN (WUZT(I)/VX2T(I))
                                                                                                                                                  W2T(1)=VX2T(1)/COS (BR2T)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       W2H(I)=VX2H(I)/COS (BR2H)
                                                                                                                                                                                                                                                                                                        VIH(I)=VUIH(I)/SIN (ARIH)
                                                                                                                                                                                                                                                                                                                                                                                  W1H(I)=VX1H(I)/COS (BR1H)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             V2H(I) = VX2H(I) / COS (AR2H)
                                                                          V2T(I)=VX2T(I)/COS (AR2T)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               WU2H(I)=VU2H(I)+UH(I)
                                                                                               MU2T(I) = VU2T(I) - UT(I)
                                                                                                                                                                                                                                                                                                                          WU1H(I)=VU1H(I)+UH(I)
                                                                                                                                                                                                                                                                                     AD1H(I)=57.296*AR1H
                                                                                                                                                                                                                                                                                                                                                                BD1H(1)=57.296*BR1H
                                                                                                                                                                                                                                                                                                                                                                                                                                                           AD2H(I)=57.296*AR2H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    BD2H(1)=57.296*BR2H
                                                       AD2T(I)=57.296*AR2T
                                                                                                                                 BD2T(I)=57.296*BR2T
                                                                                                                                                                                                                                                 VXIH(I)=VXI(I)
                                                                                                                                                                                                                                                                                                                                                                                                                       VX2H(I)=VX2(I)
                     VX2T(I)=VX2(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            S A
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 RETURN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        NOD /
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        *STORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            *DUMP
```

```
CALC5002
                                                                                                                 CALC5005
                                                                                                                                             CALC5006
                                                                                                                                                                                                           CALC5008
                                                                                                                                                                                                                                                                                                                                                                    CALC5013
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COMMON WUZT(10), BD2T(10), W2T(10), REAT(10), UH(10), VUIH(10), AD1H(10)CALC5020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC5025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC5026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC5028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),ICRS(2,10)CALC5029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CAL C5035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC5036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC5038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC5039
                                                 CALC5003
                                                                                 CALC5004
                                                                                                                                                                             CALC5007
                                                                                                                                                                                                                                         CALC5009
                                                                                                                                                                                                                                                                       CALCS010
                                                                                                                                                                                                                                                                                                                                      CALC5012
                                                                                                                                                                                                                                                                                                                                                                                                    CALC5014
                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC5015
                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC5016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC5019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC5027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC5030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC5032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC5034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC5040
                                                                                                                                                                                                                                                                                                      CALC5011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC5042
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC5031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC5041
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALCSO1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALCSO3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALCSOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALCSOZ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC502
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC502
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALCSOS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CALC504
                                                                                                                                                                                                                                         3SUMHS(2), PREOS, PREOT, IFLAG, CASEL, CASEZ, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                           ZETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2STRL(2),TUM1,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC
                                                                                                                                                                                                                                                                                                                                      COMMON X(2,10), Y(2,10), REA(2,10), Z(2,10), AD1(2,10), PRSOL, PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),P11(10),PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            4PTO(10),4ANI(10),4H1(10),4AN2(10),4H2(10),0U1(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ZWUZH(10), BDZH(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                              1V1(10), V01(10), VX1(10), W1(10), WU1(10), V2(10), VU2(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), E11(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           1, VIH(10), WUIH(10), BDIH(10), WIH(10), VUZH(10), ADZH(10), VZH(10),
                                                 AND TIP PRESSURES AND TEMPERATURES FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  COMMON VXZH(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), P12H(10),
                                                                                                                                                                             1COEM(2), N(2), DHO(2), SP(2), PRSTM(2), PRTTM(2), ETST, ETT1, ETSTM;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        4, SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5VIT(10), WULT(10), BDLT(10), WLT(10), VU2T(10), AD2T(10), V2T(10)
                                                                                                                                               COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10);VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                    COMMON UN(10) . PAS(10) . DHS(10) . BMACH . INPAR . TMANI . PMANI .
                                                                                                                                                                                                                                                                                                       SETSMM, ETTMM, PTME (2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                1PT11(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                                                                                                                      ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               []H(])=TT](])-V]H(])**2/CON]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              T1T(I)=T11(I)-V1T(I)**2/CON1
                                                                                                                                                                                                                                                                           4 PRCOS . PRCOT . PRSMM . PRTMM .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CON1=2 . *32 . 174 * 778 . 16 * CP
                                                      HUB
                                                    SUBROUTINE CALCULATÉS
                                                                                      BLADING
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CONS#GAM/CGAM-1+1
SUBROUTINE CALCS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               DT2H(I) = DT2(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     \Gamma T Z T (I) = T T Z (I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PT1T(I)=PT1(I
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PT1H(I)=PT1(I
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PT2T(I)=PT2(I
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     [T2H(I)=TT2(]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          I=1,K
                                                                                      FREE VORTEX
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5.RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         001 00
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ( L) N=X
```

```
CALC5044
CALC5045
                                                                           CALC5050
CALC5051
                         CALC5046
                                                   CALC5048
                                                               CALC5049
                                      CALC5047
   T2H(I)=TT2H(I)-V2H(I)**2/CONI
T2T(I)=TT2T(I)-V2T(I)**2/CONI
P1H(I)=PT1H(I)*(T1H(I)/TT1(I))**CON3
P1T(I)=PT1T(I)*(T1T(I)/TT1(I))**CON3
P2H(I)=PT2H(I)*(T2H(I)/TT2H(I))**CON3
                                                                 P2T(1)=PT2T(1)*(T2T(1)/TT2T(1))**CON3
  1)-V2H(I)**2/CON1
                                                                                                                       CALC5
CALC5
                                                                                                                         CD A
                                                                                RETURN
END
                                                                                                          // DUP
*STORE
*DUMP
                                                                     100
```

SUBROUTINE CALCE

NON-TWISTED BLADES USING THE RUNGE-KUTTA METHOD SUBROUTINE CALCULATES STATOR EXIT RADIAL VELOCITY DISTRIBUTION FOR

SETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH 3SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LELAG, L, 1COEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRTTM(2) .ETST.ETTT.ETSTM. ETITM.UMA(2).UCO.UCOM.RET(2).RES(2).PRST(2).PRTT(2).UMS.SUMHT(2). COMMON IM.ID.IY.R.GAM.CP.VIS.SHP(2).W.TTI(2).PTI(2).UM1(2).

1ETSOL,ETTOL,UCSOL,UCTOL,UCOT,UCOTM,AREAI COMMON UM(10).PAS(10).DHS(10).BMACH.INPAR.TMANI.PMANI. COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL,

3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10), 2W2(10), MU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10), 1V1(10) \$VU1(10),VX1(10) \$W1(10),WU1(10),VZ(10),VZ(10),VU2(10),

1.V1H(10).WU1H(10).BD1H(10).W1H(10).VU2H(10).AD2H(10).V2H(10). 5VIT(10),WULT(10),BDIT(10),WIT(10),VU2T(10),AD2T(10),V2T(10) 4PT9(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10), COMMON WUZT(10).BD2J(10).WZT(10).REAT(10).UH(10).VU1H(10).AD1H(10)CALC6020

5P2T(10).COT(10).VEP(10).DVU(10).VX1T(10).VX2T(10).VX1H(10) 4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10), 3CS(10),UC(10),RMF(10),ACI(10),ACZ(10),ACIH(10),ACZH(10),ACIT(10), 2WU2H(10), BD2H(10), W2H(10), REAH(10), T1(10), T2(10), P1(10), P2(10),

1PT1T(10),PT1H(10),TITL1(20),TITL2(20),TITL3(20), COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),

4.SECON(2.10).ARCON(2.3).SOLID(2.10).DELTA(2).OSF(2).OSEXP(2) 310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)CALC6029 2STRL(2).TUM1.TPTI.TPRST.TSP.M.RHO(2).NFLAG.WF(10).HAVE(10).STRC(

2)*(RMA/(RADA*12.))**(2.*SIN(AR1)**2)/CON1)) 1SIN(AR1)**2)/(32.174*R*RADA*(TT1-VU1**2*(1.+(COS(AR1)/SIN(AR1))**2CALC603 CON1=2.*32.174*778.16*CP DERVP(P.TT1.VU1.RADA.RMA)= P*VU1**2*(RMA/(RADA*12.))**(2.*

DO 100 I=1.J CON3=GAM/(GAM-1.)

UT(1)=(RM(1)+H2(1)/24.)*UM(1)/RM(1) AR1=AD1(L.1)/57.296

AD11(1)=AD1(L,1) VU1T(I)=VU1(I)*(RMA(I)/(RMA(I)+HI(I)/2.))**SIN(ARI)**2

VX1T(I)=VU1T(I)*COT(I)

CALC6018 CALC6017 CALC6016 CALC6015 CAL:C6009 CALC6014 CALC6013 CALC6012 CALC601:1 CALC6010 CALC6008 CALC6007 CALC6006 CALC600 CALC6.004 CALC6003 CALC6002

CALC6030 CALC6024 CALC602 CALC6023 CALC6026 CALC6025 CALC6022 CALC6021

CALC6037 CALC6036 CALC6035 CALC6034 CALC6032

CALC6031

CALC604 CALC6040 CALC6039 CALC6038

CALC6042 CALC6043

```
CALC6045
                                                                                                                                      CALC6053
                                                                                                                                                     CALC6054
                                                                                                                                                                    CALC6055
                                                                                                                                                                                    CALC6056
                                                                                                                                                                                                                                                                                                                                            CALC6066
                                                                                                                                                                                                                                                                                                                                                         CALC6.067
                                                                                                                                                                                                                                                                                                                                                                                       CALC6069
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC6076
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC6079
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CALC6082
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC6083
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC6085
CALC6044
                             CALC6046
                                          CALC6047
                                                          CALC6048
                                                                          CALC6049
                                                                                         CALC6050
                                                                                                                      CALC6052
                                                                                                                                                                                                   CALC6057
                                                                                                                                                                                                                   CALC6058
                                                                                                                                                                                                                                  CALC6059
                                                                                                                                                                                                                                                 CALC6060
                                                                                                                                                                                                                                                                               CALC6062
                                                                                                                                                                                                                                                                                              CALC6063
                                                                                                                                                                                                                                                                                                             CALC6064
                                                                                                                                                                                                                                                                                                                             CALC6065
                                                                                                                                                                                                                                                                                                                                                                         CALC6068
                                                                                                                                                                                                                                                                                                                                                                                                     CALC6070
                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC6072
                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC6073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ZALC6074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC6075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC6078
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC6080
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CAL C6081
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC6084
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC6086
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC6077
                                                                                                         CALCEOSI
                                                                                                                                                                                                                                                                CALC6061
                                                                                                                                                                                                                                                                                                                                                                                                                    CALC6071
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALCODS
                                                                                          VU1H(I)=VU1(I)*(RMA(I)/(RMA(I)-H1(I)/2.)/**SIN(ARI)**2
                                                                                                                                                                                                                                                                                                                                                            CK1=DERVP(PRR,TT1(1),VU1(1),RADA,RMA(1))
                                                                                                                                                                                                                                                                                                                                                                                                        CK2=DERVP(PRR, TT1(I), VU1(I), RADA, RMA(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                      CK3=DERVP(PRR,TT1(I),VU1(I),RADA,RMA(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CK4=DERVP(PRR,TT1(I),VU1(I),RADA,RMA(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PR=PR+DELT1/6.*(CK1+2.*CK2+2.*CK3+CK4)
                                                                              UH(I) = (RM(I) - H2(I)/24.) *UM(I)/RM(I)
                                                                                                                                                                         BRIH=ATAN(WUIH(I)/VXIH(I))
                                BRIT=ATAN(WUIT(())/VXIT(I))
                                                              W1T(I)=VX1T(I)/COS(BR1T)
                                                                                                                                                                                                      W1H(I)=VX1H(I)/COS(BR1H)
                                                                                                                                          V1H(I)=VU1H(I)/SIN(ARI)
   V1T(I)=VU1T(I)/SIN(AR1)
                                                                                                                            VX1H(I)=VU]H(I)*COT(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   DELT1=-H1(I)/(10.*12.)
                                                                                                                                                          WU1H(I)=VU1H(I)-UH(I)
                 WUIT(I)=VUIT(I)-UT(I)
                                                                                                                                                                                                                                     DELT1=H1(I)/(10•*12•)
                                                                                                                                                                                        BD1H(I)=57.296*BR1H
                                                3D1T(1)=57.296*BR1T
                                                                                                                                                                                                                                                                                                                                                                                                                         PRR=PR+DELT1*CK2/2.
                                                                                                                                                                                                                                                                                                                                                                             RADA=R1+DELT1/2.
PRR=PR+DELT1*CK1/2.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      25,35,35
                                                                                                             ADIH(I)=ADI(L.I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PRR=PR+DELT1*CK3
                                                                                                                                                                                                                                                                                                                                                                                                                                                        RADA=R1+DELT1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 R1=RMA(I)/12.
                                                                                                                                                                                                                                                                    R1=RMA(1)/12.
                                                                                                                                                                                                                                                                                                                  R1=R1+DELT1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               R1=R1+DELT1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     P11(I)=PR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      IF (K-5)
                                                                                                                                                                                                                                                                                  GO TO 30
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  PR=P1(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               GO TO 45
                                                                                                                                                                                                                                                    PR=P1(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              RADA=R1
                                                                                                                                                                                                                                                                                                                                 RADA=R1
                                                                                                                                                                                                                                                                                                                                                PRR=PR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             PRR=PR
                                                                                                                                                                                                                                                                                                   <= \( \text{+1} \)</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                K=K+1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     K
|
|
                                                                                                                                                                                                                        X || X
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       35
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               45
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 40
                                                                                                                                                                                                                                                                                                   25
                                                                                                                                                                                                                                                                                                                                   30
```

```
CALC6088
CALC6089
                                                                                                              CALC6095
                                                                                                                             CALC6096
                                                                                                                                                                               CALC6099
                                                                                                                                                                                                                                              CALC6103
                               CALC6090
                                                                                             CALC6054
                                                                                                                                                              CALC6098
                                                                                                                                                                                               CALC6100
                                                                                                                                                                                                                               CALC6102
                                                                                                                                                                                                                                                               CALC6104
                                              CALC6091
                                                               CALC6092
                                                                              CALC6093
                                                                                                                                              CALCEOST
                                                                                                                                                                                                                 CALC6101
                                                                                                                                                                                                                                                                               CALC6105
  CK1=DERVP(PRR,TT1(1),VU1(I),RADA,RMA(I))
                                               CK2=DERVP(PRR,TT1(I),VU1(I),RADA,RMA(I))
                                                                                                                                CK4=DERVP(PRR+TT1(1), VU1(1), RADA, RMA(1))
                                                                                CK3=DERVP(PRR, TT1(1), VU1(1), RADA, RMA(1)
                                                                                                                                                PR=PR+DELT1/6.*(CK1+2.*CK2+2.*CK3+CK4)
                                                                                                                                                                                                                                PT1T(I)=P1T(I)*(TT1(I)/T1T(I))**CON3
                                                                                                                                                                                                                                               PT1H(I)=P1H(I)*(TT1(I)/T1H(I))**CON3
                                                                                                                                                                                                  T1T(I)=T11(I)-V1T(I)**2/CON1
                                                                                                                                                                                                                  T1H(I)=TT1(I)-V1H(I)**2/CON1
                                                                                                                                                                                                                                                                                                                               CALC6
                                                                   PRR=PR+DELT1*CK2/2.
                                  PRR=PR+DELT1*CK1/2*
                                                                                                                                                                40,50,50
                                                                                                                 PRR=PR+DELT1*CK3
                   RADA=R1+DELT1/2.
                                                                                                 RADA=R1+DELT1
                                                                                                                                                                                  P1H(I)=PR
                                                                                                                                                                IF (K-5)
                                                                                                                                                                                                                                                                 RETURN
                                                                                                                                                                                                                                                                                  END
                                                                                                                                                                                                                                                                                                  // DUP
                                                                                                                                                                                                                                                                                                                *STORE
                                                                                                                                                                                    50
                                                                                                                                                                                                                                                   100
                                                                                                                                                                                                                                                                                                                                 *DUMP
```

SUBROUTINE CALCT

		700700
PROHITINE CALCULATES ROTOR EXIT RADIAL VELOCITY DISTREBU	UTION FOR	ALC700
BLADES USING THE RUNGE-KUTTA METHOD		LC700
		3LC700
DMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TII(2), PTI(2), U	M1(2)	3LC700
COEM(2),N(2),OHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT	• ETSTM•	1 C 7 0 0
ETTIM, UMA(2), OCO, OCOM, RET(2), RES(2), PRST(2), PRTT(2), U	UMS, SUMHT (2).	00/JTK
JMHS(2),PREOS,PPEOJ,IFLAG,CASEI,GASE2,JFLAG,KFLAG,MF	LAC . LT LAC	ロロンフェ
A STATE OF THE STA		ナロ・フレー・
ETSMM, ETTMM, PTME (2), AREAF, TECE, PECE, REACT, JPASE, FMACH	(10/07 11/07/07
COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PR	300 PRTOL .	4 L C / O L
TSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAL		10/57
COMMON (MC10) PASCIO, OHSCIO, BRACISIASK, CARTSTAND		ぜつとうほう
1(10)•VU1(10)•VX1(40)•%1(10)•%1(10)•VX1(101)•VX1(10)	* (
PACTOR TO CAR TO 1 201 (10) 2004 (10) 2004 (10) 2014	0) *PT2 (1	4 L C 7 0 1
PTO(10), ANI(10), HI(10), ANI(10), HI(10), UT(10)), AD1T (10	ALC701
V1T(10), WU1T(10), BD1T(10), W1T(10), VU2T(10), AD2T(10), V	72T(10)	ALC701
COMMON WUZT (10), 502T (10), 82T (10), REAT (10), UH (10), VUZH	4(10); AD	ALC702
, VIH(10), YU1H(10), RD1H(10), WIH(10), VU2H(10), AD2H(10),	V2H(1	10702
XU2H(10), 802H(10), W2H(10), REAH(10), T1(10), T2(10), P1(1	1.0), F2(1.0),	70/JUN
CS(10) * UC(10) * RMF(10) * AC1(10) * AC2(10) * AC1H(10) * AC2H(1	10) • AC1T	VEC702
AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H((10) (121 (10)	70/J1/
P2T(10),COT(10),VEP(10),DVU(10),VX1+(10),VXZ+(10),VXT		クロインショ
CONMON VX2M(10), RMA(10), L121(10), L12H(10), R14(10), R1	7:17	ひつとししている
TIT (10), PT [H(10), FT [L], 20), FT LECTON, TT LESTED 7.	E(101,57	10/01/2
	0) . TCRS (2.	ALC702
• SECON(2,10), ARCON(2,2), SOLID(2,10), DELTA(2), OSF(2), O	SEXP(2)	ALC703
*RT(10)		CALC703
DERVIVUZR,RAD,RADA,VUI,RNA)=OMEGA=(IVUZR/RAD)**2+VU1*	OFFIGA * (RMA/)	ALC703
ADA*12.1)**SIN(AR1)**2*COS(AR1)**2-RAD*OMBGA**2)/((1.	>) * (N**3-0)+	いのごフロエフ
2R+8AD*0V40A)		とし ハンコン
UIK (VUI *KMA) HVUI * (KMA/ KADDANIA*) PAKUIN TRII PAKA PAMATANIA		から とし しゃ
AD*OPEGA*(VOIKK+VCKR)/(S4.17*170*10*10*10*10*10*10*10*10*10*10*10*10*10	(d.)	CALC7037
X 2 R (VII 2 R 2) + (VII 2 R 2 L 8 D * OMEGA) * COS (BR2) / S I N (BR2)		ALC703
ERVP(PRR)=PRR*VU2RR*%2/(32.174*R*TRR*RAD)		ALC703
MEGA=3.14159*SP(L1/30.		ALC704
ON3-GAM/ (GAM-1.		7LC704
N(L)		すの/ ブゴネ
0.10		ザロンフル (

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		1706 1706 1706 1706 1706	0	7070 7070 7070 7070	C C C C C C C C C C C C C C C C C C C
		111111			OAL OAL
					•
			4A(I))	WA(I)	*A(1))
			NDA,VU1(I),R/ N(I))	2. 5A.vUl(I).R (I))	/2. ADA.VU1(I).R A(I).
1)/57.296 1/57.296 BR2)/SIN(BR2) IR=1,2 15),NDIR 1)/(10.*12.) I)/(10.*12.)	(1)/(10.*12. (1)/(10.*12. 1)	 +DELT1 +DELT2 R1 R2 S=VU2R	以上	SLT1/2. SLT1/2. T2/2. *+DELT2*CK1 VU2RR,RAD.R R(VU1(1),RM	R(VUZRR) RE) LTZ*CKP1/Z* P(PRR) R+DELTZ*CKZ VUZRR,RAD*R R(VU1(I),RK TT1(I))
ARI=AD1(L BR2=BD2(I COTB=COS(BO 100 ND K=1 CO TO (10 BELT2=H2(GO TO 20	5 DELTISTO VUZREVU RNERRA(I RZERMA(I GO TO 3	+ RRA II R		21=DER 24=DER 24=C 24=C 24=DER 24=DER 24=DER 24=TR	28.8.4.X.3.8.2.8.8.4.0.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3.3

```
ω
6
                                                                                                                                                                                                            50
                                                                                                                                                                                                                                           1-(VU1T(I)+VU2T(I))/(2.*UT(I))
                                                                                                                                                                                                            VU2H(1)=VU2R
                                                                                                                                                                                                                                                             REAT(1)=1.-(VXIT(1)**2-VX2T(1)**2)/(2.*UT(1)*(VUIT(1)-VU2T(1)))
                                                                                                                                                                                                                                                                              W2T(I)=VX2T(I)/COS(BR2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                         VU2T(I)=VU2R
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             PRREPREDELT2*CKP3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 VU2RR=VU2R+DELT2*CK3
                                                                                                                                                                                                                                                                                             V2T(1) = VX2T(1) / COS (AR2T)
                                                                                                                                                                                                                                                                                                                                                  VX2T(1) = WU2T(1) *COS(6R2) VSIN(6R2) = 8
                                                                                                                                                                                                                                                                                                                                                                  BD2T(I)=0D2(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                        P2T(I)=PR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                VX2RR=VX2R(VU2RR)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  RAD=R2+DFLT2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   TRR=TR(TTRR)
PRR=PR+DELT2*CKP2/2.
               PT2T(I)=P2T(I)*(TT2T(I)/T2T(I))**CON3
                                 W2H(I) = VX2H(I) / COS(BR2)
                                                  BD2H(I)=302(I)
                                                                    V2.H(I)=VX2H(I)/COS(AR2H)
                                                                                     AD2H(I)=57,296*AR2H
                                                                                                                                         WU2H(I)=VU2H(I)-UH(I)
                                                                                                                                                                                         P2H(1)=PR
                                                                                                                                                                                                                            00 10
                                                                                                                                                                                                                                                                                                               AD2T(1)=57.296*AR2T
                                                                                                                                                                                                                                                                                                                                ARZT=ATAN(VU2T(I)/VX2T(I))
                                                                                                                                                                                                                                                                                                                                                                                   MU2T(1) = VU2T(1) + UT(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             PR=PR+DELT2/6.*(CKPL+2.*AKP2+2.*ACKP3+CKP4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            VU2R=VU2R+9ELT2/6.*(CK1+2.*CK2+2.*CK3+CK4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               TTRR=TTR(TT1(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 VU1RR=VU1R(VU1(I),RMA(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CK4=DERV(VUZRR,RAD,RADA,VU1(I),RMA(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   RADA=R1+DELT1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CKP3 = DIRVP (PRR)
PT2H(I)=P2H(I)*(TT2H(I)/T2H(I))**CON3
                                                                                                                                                         TT2H(I)=TTRR
                                                                                                                                                                         T2H(1)=TRR
                                                                                                                                                                                                                                                                                                                                                                                                    T121(1)=TTRE
                                                                                                                                                                                                                                                                                                                                                                                                                     T2T(I)=TRR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           IF (X-5) 25.05.05
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 TRR=18(TTRR)
                                                                                                       AR2H=ATAN(VU2H(I)/VX2H(I))
                                                                                                                        VX2H(I)=\U2H(I)*CO$(BR2)/$IN(BR2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CKP4#DERVP(PRE)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          TO (36,50), NOIR
                                                                                                                                                                                                                            100
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC7088
                    CALC7130
                                                                                                          CALC7125
                                                                                                                                                              CALC712
                                                                                                                                                                                                               CALC7119
                                                                                                                                                                                                                             CALC7118
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC7095
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC7093
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CALC7092
                                                                        CALC7127
                                                                                         CALC7126
                                                                                                                            CALC7124
                                                                                                                                             CALC7123
                                                                                                                                                                             CALC712
                                                                                                                                                                                              CALC7120
                                                                                                                                                                                                                                             CALC711
                                                                                                                                                                                                                                                                  CAL 07116
                                                                                                                                                                                                                                                                                                                                   CALC7112
                                                                                                                                                                                                                                                                                                                                                    CALC711
                                                                                                                                                                                                                                                                                                                                                                      CALU7110
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC7099
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC7096
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC7094
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CAL C7091
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC7090
                                                       CALC7128
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALC7101
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC7100
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC7097
                                                                                                                                                                                                                                                                                   CALC7115
                                                                                                                                                                                                                                                                                                  JALC7114
                                                                                                                                                                                                                                                                                                                                                                                                       TALC7108
                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC7106
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              TALC7102
                                                                                                                                                                                                                                                                                                                                                                                                                        TALC7107
                                                                                                                                                                                                                                                                                                                                                                                                                                                           TAL 07105
                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ALC7104
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               ALC7103
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ALC7098
```

CALC7132 CALC7133 CALC7134 CALC7135 CALC7135 REAH(I)=1.-(VX1H(I)**2-VX2H(I)**2)/(2.*UH(I)*(VU1H(I)-VU2H(I)))
1-(VU1H(I)+VU2H(I))/(2.*UH(I))
100 CONTINUE
RETURN
END CALC7 // DUP *STORE *DUMP

```
CALC8020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CALC8025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC8026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)CALC8028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC8029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CALC8030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC8035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALC8038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               CALC8039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC8040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC8042
                                                                                                           CALCBOOS
                                                                                                                                                                                           CALC8008
                                                                                                                                                                                                                                                                                                                                  CALC8013
                                                                                                                                                                                                                                                                                                                                                             CALC8014
                                                                                                                                                                                                                                                                                                                                                                                        CALC8015
                                                                                                                                                                                                                                                                                                                                                                                                                   CALC8016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC8018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 COMMON WU2T(10), SD2T(10), W2T(10), REAT(10), UH(10), VU1H(10), AD1H(10)CALC8019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC8021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   CALC8022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC8023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC8024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC8033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         CALC8034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC8041
                         CALC8002
                                                   CALCBOOS
                                                                                CALC8004
                                                                                                                                     CALC8006
                                                                                                                                                                                                                       CALC8009
                                                                                                                                                                                                                                                  CAL C8010
                                                                                                                                                                                                                                                                                                                                                                                                                                             CALC8017
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALC8027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      CALC8031
                                                                                                                                                              CALC8007
                                                                                                                                                                                                                                                                             CALC8011
                                                                                                                                                                                                                                                                                                        CALC8012
CALC8001
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC8037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CALC803
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          CALC803
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              CALC804
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                ZETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2),
                                                                                                                                                                                         3SUMHS(2), PREQS, PREQT, IFLAG, CASEI, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       2STRL(2), TUM1, TPT1, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ZWUZH(10), BDZH(10), WZH(10), REAH(10), TI(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                               4PTO(10),ANI(10),HI(10),ANZ(10),HZ(10),UT(10),VUIT(10),ADIT(10),
                                                                                                                                                                                                                                                                           COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                   3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               1,V1H(10),WU1H(10),BD1H(10),W1H(10),VU2H(10),AD2H(10),V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                          2W2(10),WU2(10),BD1(10),AD2(10),BD2(10),ETS(10),ETT(10),E(10),
                                                                                                                                                                                                                                                                                                                                                               1V1(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VU2(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    COMMON VXZH(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               4.SECON(2,10),ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                                                     ICOEM(2),N(2),DHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT,ETSTM,
                                                                                                              COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TII(2), PTI(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          SVIT(10), WULT(10), BDLT(10), WLT(10), VUZT(10), ADZT(10), VZT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                      COMMON UM(10) . PAS(10) . DHS(10) . BMACH . INPAR . TMANI . PMANI .
                                                                                                                                                                                                                                                  SETSWM, ETTMM, PTME (2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                1PT1T(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                                                         ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                            MACH NUMBERS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       CALCULATION OF MACH NUMBERS
                                                                                                                                                                                                                            4PROOS , PROOT , PRSMM , PRTMM ,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           (CON2*T1H(I))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CON2*T1T(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                (CON2*T2H(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (CON2*T2T(I)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     SQ1=SQRT (CON2*T1(1))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                (CON2*T2(1))
                                                            SUBROUTINE CALCULATES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  GON2=32-174*GAM*R
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        AC1(1)=V1(1)/SQ1
      SUBROUTINE CALCE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           DO 100 I=1*K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             SQ1H=SORT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      SQ1T=SQRT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             SQ2T=SQRT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  SQ2H=SQRT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                SQ2=SQRT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ( T ) N = Y
```

ŮΨ

 \mathbf{U}

CALC8044 AC2(I)=W2(I)/SQ2 CALC8045 ACIH(I)=V1H(I)/SQ1H CALC8046 AC1T(I)=V1T(I)/SQ1T CALC8047 AC2H(I)=W2H(I)/SQ2H CALC8048 100 AC2T(I)=W2T(I)/SQ2T CALC8049 RETURN CALC8050 END // DUP *STORE UA CALCE WS .

*DUMP

UA CD CALCE

도 하고 있는 것이 되었다. 이 경기에 되었다. 	
// FOR FUNCTION ROOT (A,B,C,D,X,STRES)	ROOTOOOl
Control Contro	R00T0002
C FUNCTION SUBPROGRAM DETERMINES A NEW BLADE HEIGHT FOR STRESS	R00T0003
C PRESSURE AND PRESSURE RATIO ADJUSTING OPTIONS USING THE NEWTON RAPHSON	4R00T0004
COMETHOD OF THE REPORT OF THE PROPERTY OF THE	ROOT0005
이 🕳 이 하는 사람들은 사람들이 되었다. 그는 사람들은 사람들이 되었다. 그는 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은 사람들은	ROOT0006
10 FORMAT (//1X, 'NO SOLUTION FOR AVERAGE BLADE HEIGHT')	R00T0007
THE PROPERTY OF THE PROPERTY O	R00T0008
ROOT=X	ROOT0009
45 FH=B/ROOT+A*C*ROOT+A*D*ROOT**2-STRES	R00T0010
DFH=-B/ROOT**2+A*C+2•*A*D*ROOT	ROOTOO11
- Harana COR=FH/DEH	ROOTOO12
ROOT=ROOT-COR	ROOTOO13
NCONT=NCONT+1	ROOTO014
IF(ABS(COR/ROOT)-0.001) 100,100,50	ROOT0015
50 IF(NCONT-30) 45,45,60	RCOTO017
60 WRITE (3,10)	ROOTCO18
100 RETURN	ROOTOO19
	RCOT0020
// DUP	
*STORE WS UA ROOT	
*DUMP UA CD ROOT	

```
STRES036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               STRES038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      STRE5025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           STRES019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       STRES020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               STRES023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STRES024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STRES032
                                                                                                     STRESOOS
                                                                                                                                                              STRESOO7
                                                                                                                                                                                                                           STRES009
                                                                                                                                                                                                                                                                                                                                                                            STRES014
                                                                                                                                                                                                                                                                                                                                                                                                       STRES:015
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STRESOZZ
                                                                                                                                                                                                                                                                                    STRES011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STRESOZI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 STRES02
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                STRESOZI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STRES02
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     STRESOS
                                                                                                                                                                                                                                                          STRESO1
                                                                                                                                                                                                                                                                                                                   STRES01
                                                                                                                                                                                                                                                                                                                                               STRES01
                                                                                                                                                                                                                                                                                                                                                                                                                                   STRESOI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  STRESOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              STRES01
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        COMMON WU2T(10), BD2T(10), W2T(10), REAT(10), CH(10), VU1H(10), AD1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         F1=ARCON(L.1)/2.*(1.-DELTA(L)**2)+ARCON(L.2)/3.*(1.-DELTA(L)**3)+
                                                                                                                                                                                                                                                          SUMHS(2), PREDS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  F2=ARCON(L .1)*(1.+DELTA(L))+ARCON(L.2)/2.*(1.+DELTA(L)**2)+ARCON
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2STRL(2), TUM1, TPTI, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10)
                                                                                                                                                                                                                             ETITM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 2WU2H(10),BD2H(10),W2H(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             4PTO(10), ANI(10), HI(10), ANZ(10), HZ(10), UT(10), VUIT(10), ADIT(10),
                                            AGAINST
                                                                                                                                                                                                                                                                                                                                              COMMON X (2,10), Y (2,10), REA (2,10), Z (2,10), ADI (2,10), PRSOL, PRTOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      1.V1H(10),WU1H(10),BD1H(10),W1H(10),VU2H(10),AD2H(10),V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                              OTHER
                                                                                                                                                                                                                                                                                                                                                                                                                                     LV1(10)*VU1(10);VX1(10);M1(10);WU1(10);V2(10);VU2(10);VX2(10);
                                                                                                                                                                                               COEM(2),N(2),DHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT,ETSTM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     4, SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         5VIT(10); WULT(10); BDIT(10); WLT(10); VUZT(10); ADZT(10); VZT(10)
                                                                                                                                                                  COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                           STRESS LIMIT IF REQUIRED AND DETERMINES BRANCH TO CALCULATE BLADE ROOT STRESSES OR TO STRESS ADJUSTING SUBROUTINE
                                              STRESS, TESTS IT
                                                                                                                                                                                                                                                                                                                                                                                                        COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                                                                      SETSMM, ETTMM, PTME (2), AREAF, TECE, PECE, RFACT, 1PAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   PT1T(10), PT1H(10), TITL1(20); TTTL2(20); TITL3(20);
                                                                                                                                                                                                                                                                                                                                                                               ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                              ROOT
                                                BLADE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (ARCON(L,3)/4.*(1.-DELTA(L)**4)
                                                   SUBROUTINE CALCULATES LAST STAGE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       HAVE (K)=(H1(K)+H2(K))/2+0
                                                                                                                                                                                                                                                                                               4 PROOS, PROOT, PRSMM, PRTMM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   RH=RMF(K)-HAVE(K)/2.0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             WF(K)=X(L,K)/SUMW
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      IF (K-1) 11,11,99
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               SUMW=SUMW+X(L+1)
STRES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    DO 10 I=2+K
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           SUMW=X(L,1)
 SUBROUTINE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5.RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                (二) N=Y
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             Ó
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 10
                                                                                       UUU
```

```
STRES075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          STRES076
                                              STRB(K)=33000.*SHP(L)*WF(K)*OSF(L)**OSEXP(L)*ARS(L.K)**2/(8.*3.141STRES047
                                                            59**2*0SE(L)*SP(L)*RMF(K)**2*SECON(L,K)*SOLID(L,K)*HAVE(K)/12,*TCRSTRES048
                                                                                               STRESOSO
                                                                                                                              STRESO52
                                                                                                                                                STRESO53
                                                                                                                                                                STRES054
                                                                                                                                                                               STRESOSS
                                                                                                                                                                                                 STRES056
                                                                                                                                                                                                                 STRES057
                                                                                                                                                                                                                                  STRES058
                                                                                                                                                                                                                                                   STRES059
                                                                                                                                                                                                                                                                  STRES060
                                                                                                                                                                                                                                                                                                    STRESO62
                                                                                                                                                                                                                                                                                                                    STRESO63
                                                                                                                                                                                                                                                                                                                                    STRES064
                                                                                                                                                                                                                                                                                                                                                     STRES065
                                                                                                                                                                                                                                                                                                                                                                      STRES066
                                                                                                                                                                                                                                                                                                                                                                                      STRESO67
                                                                                                                                                                                                                                                                                                                                                                                                       SIRESOG8
                                                                                                                                                                                                                                                                                                                                                                                                                        STRES069
                                                                                                                                                                                                                                                                                                                                                                                                                                    STRES070
                                                                                                                                                                                                                                                                                                                                                                                                                                                                         STRES072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STRES073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           STRES074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STRES077
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STRES078
                                                                                                                                                                                                                                                                                     STRES061
                                                                                                               STRES051
                                                                                                                                                                                                                                                                                                                                                                                                                                                       STRES07
                                                                                                                                                                                                                                                                                                                                                                      STRB(I)=33000.*SHP(L)*WF(I)*OSF(L)**OSEXP(L)*ARS(L.I)**2/(8.*3.141
              STRC(K)=RHO(L)*HAVE(K)*(3.14159*SP(L)*OSF(L)/30.)**2/386.09*(RH*
                                                                                                                                                                                                                                                                                                                                     STRC(I)=RHO(L)*HAVE(I)*(3.14159*SP(L)*OSF(L)/30.)**2/386.09*(RH*
                                                                                                                                                                                                                                                                                                                                                                                       59**2*0SF(L)*SP(L)*RMF(1)**2*SECON(L+1)*SOLID(L+1)*HAVE(1)/12+
                               IDELTA(L)+HAVE(K)*DELTA(L)**2/2.+HAVE(K)*F1+RH*F2)
                                                                                                                                                                                                                                                                                                                                                      DELTA(L)+HAVE(I)*DELTA(L)**2/2.+HAVE(I)*F1+RH*F2)
                                                                                                                                 , NFLAG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             GO TO (41,41,41,42,42),NFLAG
                                                                                                                                                                   IF(STRT(K)-STRL(L))40,40,25
                                                                                                                                                                                   ERR=ABS(STRL(L)-STRT(K))
                                                                                                                                                                                                                                                                                                        HAVE(I) = (H1(I) +H2(I))/2.0
11.33//3.* (1.-DELTA(L)**3)
                                                                                                                                                                                                                                                                                                                                                                                                                                          STRT(I)=STRC(I)+STRB(I)
                                                                                                   STRT(K)=STRC(K)+STRB(K)
                                                                                                                                 GO TO (15,15,14,15,15)
                                                                                                                                                                                                                                                                                                                         RH=RMF(1)-HAVE(1)/2.0
                                                                                                                                                                                                    IF (ERR-200.0)20,20,40
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STRES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   STRES
                                                                                                                                                                                                                                                                                                                                                                                                                            WF(I)=WF(I)*100.0
                                                                                                                                                                                                                                                                                                                                                                                                                                                           WF (K)=WF (K)*100.0
                                                                                                                  (M-1) 20,12,12
                                                                                                                                                                                                                                    IF (K-1) 31,31,26
                                                                                                                                                                                                                                                                                       WF(I)=X(L.1)/SUMW
                                                                                                                                                                                                                                                                                                                                                                                                           2*TCRS(L+1)**2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 9
                                                                                                                                                                                                                                                                      DO 30 I=1,J
                                                                                   S(L**(X*1)S
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   Y
O
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             GO TO 43
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              GO TO 43
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              NFLAG=2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               NFLAG=5
                                                                                                                                                  NFLAG=4
                                                                                                                                                                                                                    NFLAG=1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 RETURN
                                                                                                                                                                                                                                                      J=K-1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 END
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    // DUP
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    *STORE
                                                                                                                                                                                                                     745
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                43
                                                                                                                                                                                                                                                                                                                                                                                                                                             30
                                                                                                                                                                                                                                                                                                                                                                                                                                                           31
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               40
                                                                                                                                    2
                                                                                                                                                    14
                                                                                                                                                                                    5
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   *DUMP
```

```
STRS1009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  STRS1096
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STRS1035
                                                                                                                                                                                                                                                                                                                                                                                                                                                              STRS1019
                                                                                                                                                                                                                                                                                                                                                                                                                                    STRS1018
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STR51020
                                                                                                                  STRS1006
                                                                                                                                          STRS1007
                                                                                                                                                                  STR51008
                                                                                                                                                                                                                                                                                                 STRS1013
                                                                                                                                                                                                                                                                                                                                                                                                         STRS1017
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              SIRGIOZI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 STRS1051
                                   STRS1003
                                                                                                                                                                                                                                                 STRS1011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           STRS1022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     STRS102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STRS102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STR$102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STR5102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      STR5102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 STRS102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           STRS103
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      STRS102
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              STREIOS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STRS102
                                                                                                                                                                                                                                                                       51013
                                                                                                                                                                                                                                                                                                                                                    STR5101
                                                                                                                                                                                                                                                                                                                            STR5101
                                                                                                                                                                                                                                                                                                                                                                               31R5101
                                                                                                                                                                                                                                                                         S H S
                                                                                                                                                                                                                                                                                                                                                                                                                                                                COMMON WHIZT(10),802T(10),W2T(10),REAT(10),UH(10),VU1H(10),AD1H(10
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       310),STRE(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         FI=ARCON(L,1)/2.*(1,-DELTA(L)**2)+ARCON(L,2)/3.*(1,-DELTA(L)**3)+
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        F2=ARCON(L,1)*(1,-DELTA(L))+ARCON(L,2)/2.*(1.+DELTA(L),**2)+ARCON(
                                                                                                                                                                  3 SUMIJS (2), PPEQS, PREQI, IFLAG, CASEI, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                           ZETTIM, UMA (2), UCO, UCOM, RET (2), RES (2), PRST (2), PRTT (2), UMS, SUMHT (2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             3C$(10), UC(10), RME(10), AC1(10), AC2(10), AC1H(10), AC2H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       4AC2T(10), T1H(10), T1T(10), T2H(10), P1H(10), P1T(10), P2H(10), T2T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STRE(2), TUNI, TPII, TPRST, TSP, M. RHO(2), NFLAG, WF(10), HAVE(10), STRC(
                                                                                                                                                                                                                                                                                                                                                                                 3RM(10), TT1(10), TT2(10), PRT(10), PRS(10), PRN(10), PT1(10) PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                           4PT0(10),AN1(10),H1(10),AN2(10),H2(10),9U1(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   28U2H(10);BD2H(10);WZH(10);PEAH(10);T1(10);T2(10);P1(10);P2(10);
                                                                                                                                                                                                                                                    , PRIOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1.V1H(10),WU1H(10),BB3B(10),W1H(10),VU2H(10),AB2H(10),VZH(10),
                                                                                                                                                                                                                                                                                                                            1V1(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VÜ2(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                                      2W2(10),9W2(10),9D1(10), AD2(10),8D2(10),ETS(10),ETT(10),E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4.SECON(2,10) :ARCON(2,3);SOLID(2,10);DELFA(2);OSF(2);GSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(13);
                                                                                                                  COEM(2), N(2), DHO(2), SP(2), PRSTM(2), PRITM(2), ETSI, ETTI, ETSIM,
                                                                                                                                                                                                                                                                                                                                                                                                                                      5VIT(10); WULT(10); BDLT(10); WIT(10); VU2T(10); AD2T(10); V2T(10)
                                                                                           OMMON IN ID. 1 Y FR GAM CP VIS SHP (2) W TTI (2) PTI (2) UM1 (2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                P2T(10),C0T(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                  COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL
                                                                                                                                                                                                                                                                                                      COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                        5CTSMM,ETTMM,PTGE(2),AREAF,TECR,PECE,RFACT,IPAGE,EMACH
                                         SPEED
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       PT1T(10), PT1H(10), TTTL1(20), TTL2(20), TTL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           SPEED!)
                                            BLADE
                                                                                                                                                                                                                                                                               ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTH, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           BLADE
                                            BY CHANGING MEAN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            (//1X, INO SOLUTION TO NEW
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      1ARCON(L,3)/4.*(1.-DELIA(L) **4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             1L,3)/3.*(1.-DELIA(L)**3)
                                                                                                                                                                                                     4 PRCOS , PRCOT , PRSTN', PRTEM .
                                                ADJUSTS STRESS
SUBROUTINE STRS1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5,RT(10)
                                                     SUBROUTINE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 FORMAT
```

FU=STRL(L)-RHO(L)*HU*(3.14159*SP(L)*OSF(L)/30.)**2/(386.09*UM(K)**STRS1042

11.5)*(DELTA(L)*(RUZUM(K)-HU/2.7UM(K)**1.5)+HU*DELTA(L)**2/2.7UM(K)STRS1043

STRS1037

F3=33000.*ARS(L,K).**2/(8.*3.14159**2*8ECON(L,K)*50LID(L,K)*

HU= (UM(K)**1.56)*HAVE(K)

RUERMP(K) *UN(K)

TCRS(L,K)卷卷2/12。)

```
/ DUP
                                              105
                                                                                                                                                                                                                                                                              4**0.5-3.*HU*F1/2./UN(K)**0.5+F2*(3.*HU/4./UM(K)**0.5-RU)))-3.5*F3*STR$1051
5SHP(L)*WF(K)*0SF(L)**0SEXP(L)*UM(K)**2.5/(SP(L)*0SF(L)*RU**2*HU) STR$1052
                                                                                                                                                                                                                                                                                                                                                                                                            4(K)*0SF(L)**0SEXP(L)*UZ(K)**3.5/(SP(L)*0SF(L)*RU**2*HU)
                                                                                                                                                                                                                                                                                                                                                                                                                                   2**
31.5+HU*F1/UM(X)**1.5+F2*(RU/U%(K)+HU/2./UM(K)**1.5))-F3*&HP(L)*WF
                                                                                                                                                                                                                                                                                                                           33.5%(DELTA(L)*12.*HU/4./UM(K)**0.5-RU)-3.*HU*SELTA(L)**2/4./UM(K)
                                                                                                                                                                                                                                                                                                                                             2**1.5+HU*F1/UM(K)**1.5+F2*(RU/UM(K)-HU/2./UM(K)**1.5))-1./UM(K)**
                                                                                                                                                                                                                                                                                                                                                                     12.5*(DECTA(L)*(RU/UM(K)+HU/2./UM(K)**1.5)+HU*DELTA(L)**2/2./UM(K)
                                              PETURN
                                                                                        KRITE (3,5)
                                                                                                                                                                                                                                                                                                                                                                                       DFU=RHO(L)*HU*(3.14159*SP(L)*OSF(L)/30.)**2/386.09*(3./2./UN(K)**
                                                                  STOP
                                                                                                             CO TO
                                                                                                                                                                                                                   NCONT=NCONT+1
                                                                                                                                                                                                                                        UM(K)=UM(K)-COR
                                                                                                                                                                                                                                                             COR=FU/DFU
                                                                                                                                                      TUML =UM(K)
                                                                                                                                                                         IF (NCONT-30) 51,51,105
                                                                                                                                TUM1=TUML/Y(L.K)
                                                                                                                                                                                               [F (ABS(CORZUM(K))+0.001)[53.53.52
                                                                                                                                                                                                                                                                                                                                                                                                                                            STRS1045
                                                                                                                                                                                                                                                                                                                                   21351050
                                                                                                                                                                                                                                                                                                                                                                             STRS1048
                                                                                                                                                                                                                                                                                                                                                         STRS1049
                                                                                                                                                                                                                                                                                                                                                                                                   STRS104
                                                                                                                                                                                                                                                                                          STRS1052
                                                                                                STRS1061
                                                                                                                                                                                                                                                                     STRS1053
                                 STRS1:064
                                                                                                                     STRS1060
                                                                                                                                          STRSLOS9
                                                                                                                                                             57851058
                                                                                                                                                                                  57251057
                                                                                                                                                                                                      STRELOSS
                                                     17 RS1063
                                                                            57251062
                                                                                                                                                                                                                           TRS1055
                                                                                                                                                                                                                                               TRS1054
```

*STORE

CAS

G ⊊

STRS1

SUBROUTINE STRS2

```
STR52002
                                                                             STR52005
                            STR52003
                                                      STR52004
                                                                                                                                                                                                      STR52010
                                                                                                                                                                               STR52009
                                                                                                                                                                                                                                                                                                     STRS2014
                                                                                                                                                                                                                                                                                                                                                                                                      STR52018
                                                                                                                                                                                                                                                                                                                                                                                                                               STR52019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               STRS2025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      STRS2026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STRS2028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STRS2029
                                                                                                                                                                                                                                                                                                                                                                              STR 5201
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STRS2027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STR52030
                                                                                                                                                                                                                                                                                                                                                   STR 5201
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              STRS202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            STR52031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     STRS2032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    STR52036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     STRS2038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       STR5202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STR5203
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      STR5203
                                                                                                                                                                         3SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L.
                                                                                                                                                                                                                                                                                                                                                                                                                                                  COMMON WUZT(10). BD2T(10). WZT(10). REAT(10). UH(10). VUIH(10). ADIH(10)
                                                                                                                                               2ETTIM.UMA(2).UCO.UCOM.RET(2).RES(2).PRST(2).PRIT(2).UMS.SUMHT(2).
                         RATIO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        F1=ARCON(L,1)/2.*(1.-DELTA(L)**2)+ARCON(L,2)/3.*(1.-DELTA(L)**3)+
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         3CS(10),UC(10),RMF(10),AC1(10),AC2(10),AC1H(10),AC2H(10),AC1T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        F2=ARCON(L,1)*(1.-DELTA(L))+ARCON(L,2)/2.*(1.-DELTA(L)**2)+ARCON(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                2STRL(2), TUM1, TPTI, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), STRC(
                                                                                                                                                                                                                                                 COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                 4PT0(10), AN1(10), H1(10), AN2(10), H2(10), UT(10), VUIT(10), AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ZWUZH(10),BDZH(10),WZH(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                                                                                                        3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10)
                                                                                                                                                                                                                                                                                                                       1VI(10), VU1(10), VX1(10), W1(10), WU1(10), V2(10), VU2(10), VX2(10),
                                                                                                                                                                                                                                                                                                                                               2W2(10),WU2(10),BD1(10),AD2(10),BD2(10),ETS(10),ETT(10),E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          1.VIH(10).WU1H(10).BD1H(10).W1H(10).VU2H(10).AD2H(10).V2H(10).
                                                                                                                        (COEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRTTM(2) .ETST.ETTT.ETSTM.
                                                                                                COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10);
       STRESS BY CHANGING INLET PRESSURE , PRESSURE
                                                                                                                                                                                                                                                                                                                                                                                                                         5V1I(10) *WUIT(10) *BD1I(10) *WIT(10) *VU2T(10) *ADZI(10) *V2T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4.SECON(2,10),ARCON(2,3),SOLID(2,10),DELTA(2),OSF(2),OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         F3=33000.*ARS(L.K)**2/(8.*3.14159**2*SECON(L.K)*SOLID(L.K)*
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                 COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TWANI, PMANI,
                                                                                                                                                                                                                          ETSMM.ETTMM.PTME(2).AREAF.TECE.PECE.RFACT.IPAGE.EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PT1T(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                           ETSOL, ETTOL, UCSÓL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 1ARCON(L.3)/4.*(1.-DELTA(L)**4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   GO TO (110,65,70,70,70) ,NFLAG
                                                                                                                                                                                                   4PROOS, PROOT, PREMM, PRIMM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               L.3)/3.*(1.-DELTA(L)**3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          GO TO (60,70,60,100) ,M
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  TCRS(L,K)**2/12.)
SUBROUTINE ADJUSTS
                          OR ROTATIVE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NFLAG=3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     K=N(L)
```

```
STRS2066
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STRS2074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                STRS2075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   STRS2076
               STRS2045
                                                                             STR52048
                                                                                                                   STR52050
                                                                                                                                                                                                                                                                                                                    STR.52060
                                                                                                                                                                                                                                                                                                                                                                             STR52063
                                                                                                                                                                                                                                                                                                                                                                                                STRS2064
                                                                                                                                                                                                                                                                                                                                                                                                                   STRS2065
                                                                                                                                                                                                                                                                                                                                                                                                                                                         F5=F4*(DELTA(L)*ARA*(DELTA(L)-1.)/120./UM(K)/OSF(L)+ARA*(F1-F2/2.)STRS2057
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             STR52068
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                STRS2069
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  STR52070
                                                                                                 STR52049
                                                                                                                                                                             STRS2053
                                                                                                                                                                                                                                                         STR52057
                                                                                                                                                                                                                                                                              STRS2058
                                                                                                                                                                                                                                                                                                 STRS2059
                                                                                                                                                                                                                                                                                                                                        STRS2061
                                                                                                                                                                                                                                                                                                                                                           STR52062
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       STRS2072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          STRS2073
                                                      STRS2047
                                                                                                                                      STRS2051
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   STR52071
                                                                                                                                                                                                                  STRS205.
STR5204
                                                                                                                                                         STRS205
                                                                                                                                                                                               C=(1.--(1.-/PRSTM(L))**((GAM-1.-)/GAM))*(HAVE(K)/PRSTM(L)/THAVE)**FACSTRS205
                                                                                                                                                                                                                                      STRS205
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 F6=F4*30.*UM(K)*OSF(L)*(DELTA(L)+F2)/3.14159
F7=F3*SHP(L)*OSF(L)**OSEXP(L)*WF(K)*2.*3.14159**2/30./UM(K)/OSF(L
 Q(1) = RHO(L) *(3.14159*SP(L) *OSF(L) /30.) **2/386.09
Q(2) = F3*SHP(L) *WF(K) *OSF(L) **0SEXP(L) / (SP(L) *OSF(L) *RMF(K) **2)
                                                                                                                                                                                                                                                              ***
                                                                                                                                                                                                                                                          FP=(GAM-1.0)/GAM*(1.0/(TPRST**((2.0*GAM-1.0)/GAM)))-FACT
                                                                                                                                                                                                                                                                                                                                                                                                                                       F4=RHO(L)*ARA*(3.14159/30.)**2/60./386.09/UM(K)/OSF(L)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  TSP=SORT((-F6+SORT(F6**2-4.*F5*F7))/2./F5)/OSF(L
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        F (ABS(ARCON(L,2))+ABS(ARCON(L,31)) 105,104,105
                                                                                                                                                                                                                                         F=1.0-(1.0/TPRST)**((GAM-1.0)/GAM)-C*TPRST**FACT
                                                                              THAVE=ROOT(Q(1),Q(2),Q(3),Q(4),HAVE(K),STRL(L))
                                                           Q(4)=DELTA(L)**2/2.-0.5*(DELTA(L)+F2)+F1
                                                                                                                                                                                                                                                                                                                                                                                                   F (ABS(CORR/TPRST)-0.001)110:110:150
                                        Q(3)=DELTA(L)*RMF(K)*(DELTA(L)+F2)
                                                                                                                                                                                                                                                                                                                                                                                                                        ARA=2.*3.14159*RMF(K)*HAVE(K)
                                                                                                                        TPTI=PTI(L)*HAVE(K)/THAVE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  760.7UM(K) /OSE(L))/144.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            TSP=SQRT(-F7/F6)/OSF(L)
                                                                                                                                                                                                                                                                                                     F (FP) 160,155,155
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        STRS2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         STRS2
                                                                                                      IF (M-3)80,140,140
                                                                                                                                                                                                                                                                                                                                                                                   PRST=TPRST-CORR
                                                                                                                                                                                                                                                                                  TPRST**(FACT-1.)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1/ARA/12.-STRL(L)
                                                                                                                                                                TPRST=PRSTM(L)
                                                                                                                                                                                  FACT=1.3333333
                                                                                                                                                                                                                                                                                                                        TPRST=TPRST+1.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Ä
                                                                                                                                           GO TO 110
                                                                                                                                                                                                                                                                                                                                              GO TO 150
                                                                                                                                                                                                                                                                                                                                                              CORREF/FP
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Siz
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         JA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        RETURN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ANO //
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       *STORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         110
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      105
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                104
                                                                                                                                                                                                                                             150
                                                                                                                                                                                                                                                                                                                                                                 160
                                                                                                                                                                                                                                                                                                                                                                                                                          100
                                                                                                                          80
                                                                                                                                                                                                                                                                                                                          155
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          *DUMP
       20
                                                                                                                                                                  140
```

```
PERCVALL040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OVALL036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        OVALL037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       OVALL038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OVALL039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OVALL029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  OVALL035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OVALL024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OVALLO25
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OVALL028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ÖVALLÖ30
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      OVALL034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        OVALL041
                                                                                                                          OVALLOOS
                                                                                                                                                       OVALL006
                                                                                                                                                                               OVALL007
                                                                                                                                                                                                             OVALL008
                                                                                                                                                                                                                                       OVALL009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OVALL019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    COMMON WUZI(10), BDZI(10), WZI(10), REAI(10), UH(10), VUIH(10), ADIH(10) OVALL620
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OVALE022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       OVALL023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    OVALL027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                0VALL032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OVALL033
                                   OVALLO02
                                                                                                  DVALLCO4
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   OVALL031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   OVALL021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OVALLO2
                                                                                                                                                                                                                                                                                               OVALLO 1
                                                                                                                                                                                                                                                                  OVALLOI
                                                                                                                                                                                                                                                                                                                          OVALLO 1
                                                                                                                                                                                                                                                                                                                                                      OVALLOI
                                                                                                                                                                                                                                                                                                                                                                                  OVALL01
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    OVALLO1
                                                                                                                                                                                                                                                                                                                                                                                                                                         OVALLOI
                                                                                                                                                                                                                                                                                                                                                                                                               OVALLOI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OVALLOI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           310);STRB(10);STRT(10);COE(2:2:10);CLEAR(2:10);ARS(2:10);TCRS(2:10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                       SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       3CS(10);UC(10);RMF(10);AC1(10);AC2(10);AC1H(10);AC2H(10);AC1T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 2STRL(2), TUM1, TPII, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), STRC
                                                                                                                                                                                                             ETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ZWUZH(10), BDZH(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    3RM(10) +TT1(10) +TT2(10) +PRT(10) +PRS(10) +PRN(10) +PT1(10) +PT2(10) +
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              4PTO(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10),
                                                                    SITI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FORMAT (///6H DATE 'A2,1H-,A2,1H-,A2,32X,30HOVER-ALL TWO-SPOOL
                                                                                                                                                                                                                                                                                                                         COMMON X(2,10), Y(2,10), REA(2,10), Z(2,10), AD1(2,10), PRSOL, PRTOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ., V1H(10), WU1H(10), BD1H(10), W1H(10), VUZH(10), AD2H(10), V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                         2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                              V1(10),VU1(10),VX1(10), N1(10), MU1(10),V2(10),VU2(10),VX2(10),
                                                                                                                                                                                COEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRTTM(2) .ETST .ETTT .ETSTM .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    4, SECON(2, 10), ARCON(2, 3), SOLID(2, 10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5V1T(10), WULT(10), BD1T(10), WLT(10), VU2T(10), AD2T(10), V2T(10)
                                                                  SUBROUTINE CALCULATES OVERALL TWO-SPOOL PERFORMANCE AND PRINTS
                                                                                                                                                     COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TII(2), PTI(2), UMI(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  FORMAT (41X,38HFIRST SPOOL INLET TO SECOND SPOOL EXIT//)
                                                                                                                                                                                                                                                                                                                                                                                  COMMON UM(10), PAS(10), DHS(10), PNACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                                                 ETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               SECOND SPOOL EXIT//
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PT1T(10),PT1H(10),TTTL1(20),TTTL2(20),TTTL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        UCOVL(DH)=UMAOL/SQRT(2.*32.174*778.16*DH)
                                                                                                                                                                                                                                                                                                                                                           ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  (42X,35HMANIFOLD INLET TO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     DH(PR)=CP*T*(1.-(1./PR)**CON4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               1FORMANCE, 38X, 4HPAGE, 13///)
                                                                                                                                                                                                                                                                         4PROOS , PROOT , PRSMM, PRIMM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          DHOVL = DHO (1) + DHO (2)
                      SUBROUTINE OVALL (J)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ET (DH) = (D1+D2) / DH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    D1=DHO(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             D2=DHO(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       =111(1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5,RT(10)
                                                                                                           INFORMATION
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               X = N (2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         20
F 0 P
                                                    \cup \cup \cup \cup
```

```
OCIMW=OCONF(DHIMW)
OVALLOST
                                                            NCIWE - OCONF (DRIWE)
OVALL036
                                                            UCTOM=UCOVL(DHTOM)
480114VO
                                                            NCTOL=UCOVL(DHTOL)
480774A0
                                                            NC 2WW = NCONT (DH2WW)
OVALLOSS
                                                            DC SWF = DCOAF (DHSWF)
OVALLOSZ
                                                            NC 20M=NCOAT ( DH20W)
CAMPLOST
                                                            ACCOL = UCOVE ( DHSOL)
080JJAV0
                                                      OMAOL = (UMA(1) +UMA(2))\2.
9Y0JJAVO
                                                               ELIWW=EL(DHIWW)
SYCLLO78
                                                               ELIMF=EL(DHIMF)
17011AVO
                                                               ELIOW=FI(DHIOW)
OVALLO76
                                                               ELIOF=F1(DH1OF)
CVALLOIS
                                                               EL 2WW=EL (DH2WW)
PLOJIAVO
                                                               ELRW[=El(DHRW[)
OVALLO73
                                                               EL 20W=EL (DH20W)
OVALLOIZ
                                                               EL 20 = EL (DH20 F)
INDIANO
                                                               DHIWW=DH(BKIWW)
OVALLO70
                                                               DHIWF=DH(5KIWF)
69077VA0
                                                               DHIOW=DH(6810W)
OAMFF068
                                                               OHTOL=DH(PRTOL)
DVALLOGY
                                                               DH2WW=DH(BB2WW)
990774A0
                                                               DHRWE = DH(BRRWE)
GAALLO65
                                                               DHROM=DH(PRSOM)
79077V0
                                                               DH2OF = DH ( bB2OF )
SACLOSS
                                                       DBIWW=BBITW(I)*BBITM(S)
DAMLLOSZ
                                                    PRIML=PRIT(I)*PRITM(2)
IGOLLAVO
                                                        PRIOM=PRITM(1)*PRIT(2)
OVALLO60
                                                         bb10 = bb11(I)*bb11(S)
OVALLO59
                                                       PRSMM=PRTTM(I)*PRSTM(Z)
BEOTTANO
                                                        bk2WF=bk11(I)*bk21W(S)
OVALLOSY
                                                        bB2OW=bELLW(I)*bB21(S)
OVALLOS6
                                                         bBROF=bBIL(I)*bBR21(S)
GAVITODE
                                                             CONT = (CAM-I.) \CAM
44077VA0
                                                                   te EORMAT (IHI)
OVALLOS3
                                                                       3 + CEIO*I)
CVALLOSZ
                                                                            NI-Z
                                                      VISa
DEC BYLETO SETO SOAVEFORT
                                 DEC 15
                                          VISd
                                                                           IAREA
                                                      1d
                                                             MUN HDAM
                H09/ 1
SCONVELOSO
              40 FORMAT (40X,40HEXHAUST COLLECTOR EXIT FLANGE CONDITIONS///60H
64011AVO
                                                        5\2EC\5EIO*I*8EIO*3\\\)
OVALLO48
                                                                ELSL
                                                                          II PRII
                                                     FILL
                         KES \SOH
                                          RET
               RIOVER
FTOVALLOHY
                                                        32 FORMAT (100H , DEL H
                                   00/0
                                               AMU
              PRST
                        NCO.
9407740
                 30 FORMAT (40X, 40HMANIFOLD INLET TO EXHAUST COLLECTOR EXIT\/)
CAMPLICAS
                  25 FORMAT (41X 39HMANIFOLD EXIT TO EXHAUST COLLECTOR EXITY)
PALLOCA
```

```
680 LIAVO
      DHOOL=DHO(1)+DHO(2)
                                                                               OVALL089
      SUHTO=SUMHT(1)+SUMHT(2)
                                                                               OVAL LOGO
      SUHSO=SUMHS(1)+SUMHS(2)
                                                                               OVALLO91
      RESOL = SUHSO/DHSOL.
                                                                               DVALLD92
      RESOM=SUHSO/DHSOM
                                                                               OVALLO93
      RESML = SUHSOZDHSML
                                                                               OVALL 094
      RESMM=SUHSO/DHSMM
                                                                               OVALL095
      RETOL=SUHTO/DHTOL
                                                                               OVALL096
      RETOM=SUHTO/DHTOM
                                                                               OVALL097
      RETML =SUHTO/DHTML
                                                                               OVALED98
      RETMM=SUHTO/DHTMM
                                                                               OVALL 699
      IF (J-1) 200,200,100
                                                                               OVALL 100
  100 IPAGE=IPAGE+1
                                                                               OVALL101
      WRITE (3,45)
                                                                               OVALL102
      WRITE (3,10) IM, ID, IY, IPAGE
                                                                               OVALL 103
      WRITE (3.15)
      WRITE (3,35) DHOVL, UMAOL, UCSOL, UCTOL, PRSOL, PRTOL, ETSOL, ETTOL,
                                                                               OVALL104
                                                                               CVALL 105
     1RESOL • RETOL
                                                                               OVALL 106
      WRITE (3,20)
      WRITE (3,35) DHOVL, UMAOL, UCSOM, UCTOM, PRSOM, PRTOM, ETSOM, ETTOM,
                                                                               OVALL107
                                                                               OVALLIOS.
     1RESOM, RETOM.
                                                                               OVALL109
      WRITE (3,25)
      WRITE (3,35) DHOVL , UMAOL , UCSML , UCTML , PRSML , PRTML , ETSML , ETTML .
                                                                               OVALUIDO.
                                                                               CVALL111
     TRESMI . RETML
                                                                               OVALL112
      WRITE (3.30)
      WRITE (3.35) DHOVL . UMAOL . UCSMM . UCTMM . PRSMM . PRTMM . ETSMM . ETTMM .
                                                                               OVALL113
                                                                               OVALL114
   - IRESMM.RETMM
      WRITE (3,40) AREAF, EMACH: ,PTME(2), PECE, TT2(K), TECE
                                                                               OVALL115
                                                                               OVALLT16
  200 RETURN
                                                                               OVALL117
      END
// DUP
```

*STORE

*DUMP

WS UA OVALL

UA CD OVALL

```
FOR
```

SUBROUTINE PRINTS INPUT INFORMATION FOR BOTH SPOOLS SUBROUTINE OUTPI \cup \cup

SUTPT004

OUTPT002 OUTPT003

OUTPION

OUTPT006 OUTPT008 OUTPT009 OUTPT010 OUTPT005 OUTPT007 **OUTPT011** ZETTTM.UMA(2).UCO.UCOM.RET(2).RES(2).PRST(2).PRTT(2).UMS.SUMHT(2). SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L, LCOEM(2).N(2).DHO(2).SP(2).PRSTM(2).PRTTM(2).ETST.ETTT.ETSTM. COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), WATTI(2), PTI(2), UMI(2), 4PROOS, PROOT, PRSMM, PRIMM.

COMMON X (2,10), Y (2,10), REA (2,10), Z (2,10), ADI (2,10), PRSOL, PRTOL ETSMM, ETTMM, PINE (2), AREAF, TECE, PFCE, RFACT, IPAGE, EMACH ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI

OUTPT012

OUTPIC13

OUTPT01 OUTPTOI

2W2(10);WU2(10);BD1(10);AD2(10);BD2(10);ETS(10);ETT(10);E(10); VI(10), VUI(10), VXI(10), WI(10), WUI(10), VZ(10), VUZ(10), VXZ(10) COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,

3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10); 4PT0(10),ANI(10),HI(10),ANZ(10);HZ(10),UT(10),VUIT(10),ADIF(10); 5V1T(10), WULT(10), BDLT(10), WLT(10), VUZT(10), ADZT(10), VZT(10)

COMMON WUZT(10), BD2T(10), W2T(10), REAT(10), UH(10), VUIH(10), ADIH(10)

OUTPIC20

0UTP101

CUTPIOL

OUTPIO

OUTPIOL

OUTPT02 OUTPT02 OUTPT02 OUTPT02

2WU2H(10), BD2H(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10), 1, V1H(10), WU1H(10), BD1H(10), W1H(10), VU2H(10), AD2H(10), V2H(10),

4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10), 3CS(10),UC(10),RMF(10),AC1(10),AC2(10),AC1H(10),AC2H(10),AC1T(10), 5P2T(10),COT(10),VEP(10),bVU(10),VX1T(10),VX2T(10),VX1H(10)

OUTPT025

CUTPT0'28

OUTP1027

OUTPT02

0UTP7030

OUTPT03

0UTPT032

310),STRB(10),STRT(10),COE(2,Z,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)OUTPT029 2STRL(2),TUM1,TPTI,TPRST,TSP,M,RHO(2),NFLAG;WF(10),HAVE(10),STRC(COMMON VXZH(10), RMA(10), TT2T(10), TF2H(10), PT2T(10), PT2H(10), IPTIT(10), PTIH(10), TITL1(20), TITL2(20), TITL3(20),

4.SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)

FORMAT (1H1)

STAGE,48X,4HPAGE,13,0UTPT033 5 FORMAT (///5H DATE, A2, 1H-, A2, 1H-, A2, 43X, 12, 6H 1/51X,18HGAS TURBINE DESIGN/56X,8HANALYSIS///)

/17X;6HLB/SEC,8X;5HDEG_R;13X;4HPSIA;12X;6HFT/SEC;10X;3HRPOUTPT039 6 FORMAT (7/52X,15HCASE CONDITIONS//3X,5HSHAFT,10X,4HFLOW,7X,11HINLEGUTPT035 9HE.C. LOSS/1X.10HHORSEPOWER.7X.4HRATE.7X.11HTEMPERATUROUTPTO37 17 TOTAL, 6X, 11HINLET TOTAL, 6X, 10HMEAN BLADE, 6X, 8HROTATIVE, 7X, 3E,7X,8HPRESSURE,10X,5HSPEED,10X,5HSPEED,8X,11HCOEFFICIENT

COLLPI042 •9HMAN• LOSS•5X•9HE•C• LOSS/1X•10HHÖRSEPOWER•5X•4HRATE•5XOUTPIQ43 (//52x,15HCASE CONDITIONS//3x,5HSHAFT,8x,4HFLOW,5x,11HINLETOUTPT041 I TOTAL, 4X, 11HINLET TOTAL, 4X, 10HMEAN BLADE, 4X, 8HROTATIVE, 5X 7 FORMAT

OUTPT040

```
OUTPT068
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               OUTPT069
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              OUTPT070
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   001PT079
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      OUTPT085
3.11HTEMPERATURE.5X,8HPRESSURE.8X,5HSPEED.8X,5HSPEED.6X,11HCOEFFICIOUTPT044
4ENT.3X,11HCOEFFICIENT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  OUTPT063
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             OUTPT064
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTPT065
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        CUTPT066
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     JUTPT067
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       1.,4x, LOSS.,5x, LOSS.,3x, CLEAR.,4x, RATIO.,4x, RATIO.,3x, MODULUSOUTPT072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      2*//22X; DEG: ,5X, RATIO: ,3X, RATIO: ,5X, RATIO: ,5X, COEFF. ,3X, COEFFOUTPTO/3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   OUTPT074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OUTPT075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             0UTPT076
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        0UTPT078
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  POUTPT080
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             CUTPT032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          11NDEX,10X, DATA SWITCHES ON'/5X, 3HPSI, 14X, 8HLB/CU-IN, /F10, 1, F18, 3, CUTPT083
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           CUTPT084
                                                        OUTPT046
                                                                                   8 FORMAT (1x, F8, 1, 6x, F6, 2, 6x, F6, 1, 2(9x, F6, 1), 6x, F7, 1, 7x, F5, 3, 9x, F5, 30UTPT047
                                                                                                                                                   OUTPT049
                                                                                                                                                                                 S/OUTPT050
                                                                                                                                                                                                              CUTPT051
                                                                                                                                                                                                                                                                                                                                 14 FORMAT (7/52X,15HCASE CONDITIONS//3X,5HSHAFT,10X,4HFLOW,7X,11HINLEOUTPT055
                                                                                                                                                                                                                                                                                                                                                                0UTPT056
                                                                                                                                                                                                                                                                                                                                                                                           *9HMAN* LOSS/1X*10HHORSEPOWER,7X,4HRATE,7X,11HTEMPERATURGUTPIG57
                                                                                                                                                                                                                                                                                                                                                                                                                          OUTPT058
                                                                                                                                                                                                                                                                                                                                                                                                                                                      17X,6HLB/SEC,8X,5HDEG R,13X,4HPSIA,12X,6HFT/SEC,10X,3HRPOUTPT059
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        OUTP1050
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CUTPINGI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTPT062
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           21 FORMAT (9x, 'REACTION', 4x, 'ANGLE', 4x, 'LOAD', 4x, 'RADIUS', 3x, 'VELOCITYGUTPTO71
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTP1081
                                                                                                                                                                                                                                                                      OUTPT053
                                                                                                                                                                                                                                                                                                     0UTP1054
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            CUTPTO7
                                                                                                                                                                                                                                         OUTPIOS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              38 FORMAT (1X, 12HSTRESS LIMIT, 5X, 16HMATERIAL DENSITY, 5X, 15HPARAMETER
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    20 FORMAT (6X, BLADE CROSS SECTION AREA DISTRIBUTION', 5X, DELTA', 5X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        19 FORMAT (2X,12,6X,F6,3,5X,F5,2,4X,F5,3,3X,F5,3,5X,FF,3,3,5X,F5,3,4X)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  (///5H DATE, A2, 1H-, A2, 1H-, A2, 43X, I2, 6H STAGE, 45X, 10HINDEX
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               1 * NOZZLE * , 3X ; * STAGE * , 4X ; * MEAN * , 5X ; * AXIAL * , 5X ; * NOZZLE * , 3X ; * ROTOR * ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 1.OVERSPEED FACTOR.,5X, OVERSPEED EXPONENT'//3E14.5,F11.3,F15.3,
                                                                                                                                                                                 53X,14HGAS PROPERTI
                                                                                                                                                                                                                                           38HABSOLUTE/15X,8HCONSTANT,19X,5HRATIO,21X,13HSPECIFIC HEAT,17X,
                                                                                                                                                                                                                                                                      49HVISCOSITY/15X,8HFT/DEG R,45X,12HBTU/LB-DEG R,18X,9HLB/FT-SEC)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    8 FORMAT (49X, STAGE INPUT PARAMETERS //IX, STAGE ,4X, STAGE , 6X
                                                                                                                                                                                                              2/17X,3HGAS,18X,13HSPECIFIC HEAT,15X,17HCONSTANT PRESSURE,15X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          23X, 'ROTOR', 4X, 'ASPECT', 3X, 'TH/CD', 3X, 'SECTION', 3X, 'SOLIDITY')
                                                                                                                                                                                                                                                                                                                                                                  1T TOTAL, 6X, 11HINLET TOTAL, 6X, 10HMEAN BLADE, 6X, 8HROTATIVE, 7X
                                                                                                                                                                                                                                                                                                                                                                                                                          3E,7X,8HPRESSURE,10X,5HSPEED,10X,5HSPEED,8X,11HCOEFFICIENT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       (1X,F8.1,8X,F6.2,8X,F6.1,2(11X,F6.1),8X,F7.1,9X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   1AGE/51X,18HGAS TURBINE DESIGN/56X,8HANALYSIS///)
                                                                                                                                                                                                                                                                                                       13 FORMAT (15x, F7.2, 19x, F6.3, 24x, F6.3, 20x, £11.4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1F5.3,3X,F5.3,4X,F4.2,5X,F4.2,5X,F5.3,5X,F5.3)
                                                                                                                                                         ,12,4H OF
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ----,20A4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      -,20A4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             1X, 18HCHARACTERISTICS **** 20A4)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ( NO
                                                                                                                                                         (1H+,48X,13HSPOOL NUMBER
                                                               5X,4HPSIA,10X,6HFT/SEC,8X,3HRPM)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     100X,11HCASE NUMBER/)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       (1X, 18HAPPLICATION--
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            1X,18HOBJECTIVE---
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           (64X**DATA SWITCHES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            (//.BNON: XOX:++
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          3.1,3X,'IN',24X,'CONST.')
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 * + * * 500 X * 14 15 / / )
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         2F23 + 3//)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             17 FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            2F5.3//
                                                                                                                                                              10 FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                FORMAT
                                                                                                                                                                                             FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   υ
ΣΣ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      33
```

```
OUTPT038
         980TGTUG
                  OUTPT090
                            OUTPT091
                                      OUTPT092
                                               0UTPT093
                                                         001PT094
                                                                  OUTPT095
                                                                             0UTPT096
                                                                                     OUTPT097
                                                                                                SUTPT098
                                                                                                          OUTPT099
                                                                                                                   OUTPT100
                                                                                                                             OUTPTIOI
                                                                                                                                       OUTP1102
                                                                                                                                               OUTPT103
                                                                                                                                                          OUTPT104
                                                                                                                                                                   OUTPT105
                                                                                                                                                                              OUTPT106
                                                                                                                                                                                                                                                                                                 OUTPT118
                                                                                                                                                                                                                                                                                                           OUTPT119
                                                                                                                                                                                                                                                                                                                      OUTP1120
                                                                                                                                                                                                                                                                                                                                           OUTPT122
                                                                                                                                                                                                                                                                                                                                                    OUTPT123
                                                                                                                                                                                                                                                                                                                                                                      OUTPT125
                                                                                                                                                                                                                                                                                                                                                                                 OUTPT126
                                                                                                                                                                                                                                                                                                                                                                                                               0UTP1129
                                                                                                                                                                                                  OUTP1108
                                                                                                                                                                                                                                                                                                                                                                                                      0UTPT128
                                                                                                                                                                                                                                                                                                                                                                                                                         OUTPT130
                                                                                                                                                                                       OUTPT10
                                                                                                                                                                                                                                                                                                                                SUTPT12
                                                                                                                                                                                                          OUTPTIO
                                                                                                                                                                                                                                                                                                                                                              OUTPIL2
                                                                                                                                                                                                                                                                                                                                                                                           OUTPT12
                                                                                                                                                                                                                                                                                       CUTPTIL
                                                                                                                                                                                                                                                                     OUTPIL
                                                                                                                                                                                                                                                                               OUTPT11
                                                                                                                                                                                                                                                                                                                                                                                                                                  OUTPT1
                                                                                                                                                                                                                     CUTPTI
                                                                                                                                                                                                                               OUTPT.
                                                                                                                                                                                                                                                  OUTPT:
                                                                                                                                                                                                                                                           OUTPTI
                                                                                                                                                                                                                                        THINC
                                                                                                                                                                                                                                                                                                                                                                                                               SHP(L) : W.TTI(L) : PII(L) : UMI(L) : SP(L) : COEM(I) : COEM(Z)
                                                                                                                                                                                                                                                                                                                                                                                 SHP(L), W,TTI(L), PTI(L), UM1(L), SP(L), COEM(L)
                                                                                                                                                                                                                                                                                                                                                                                                                                  (3,20) (ARCON(L-1),1=1,3),DELTA(L),OSF(L),OSEXP(L)
                                                                                                                                                                                                                                        M.ID.IY.K.IPAGE
L.LFLAG
                                                                                                                                                                                                                                                                                                                      R.GAM.CP.VIS
                                                                                                                                                                                                                                                                               CASEI, CASE2
                                                                                                                                                                                                  3,371 IM, ID, IY, K
                                                                                                                                                                                                                                                                                                                                 118,117) ,LFLAG
                                                                                                                                                                                         115,1351,JFLG
                                                                                                                                        215,215,220
                                                                                                                                                                                                                                                                                                                                                                                                                          120 + 120 + 130
                                                CALL DATSW (LSW.JSW)
                                                        GO TO (160,165), JSW
                                                                                                                                                                                                                                                                    TITLI
                                                                                                                                                                                                                                                                                        T11L2
                                                                                                                                                                                                                                                                                                  TITL3
                                                                                                                                                                                                                                                                                                                                          137,1381, L
                                                                                                 GO TO (2:00,210),L
                             DO 165 ISW=1,16
                                                                              NSM(KSM)=FSM
                                                                                                                                                                                                                                                                                                                     3,13).
                                                                                                                                                                                                                                                                                                                                                                                  3,17)
                                                                                                                                                                                                                                                                                                  3,361
                                                                                                                                                                                                                                                                                                                                                     3,14)
                                                                                                                                                                                                                                                                     3,31)
                                                                                                                                                                                                                                                                                         3,35)
                                                                                                                                                                                                                                                                                                            3,341
                                                                                                                                                                                                                                                            3,32
                                                                                                                                                                                                                                                                                3,33
                                                                                                                                                                                                                                                                                                                                                                         3,6)
                                                                                                                                                                                                                                                                                                                                                                                                                3,8)
                                                                                                                                                                                                                                                                                                                                                                                                      3,7)
         JFLG=JFLAG
                                                                                                                    GO TO 230
                                      LSW=ISW-1
                                                                                                                                                           GO TO 230
                                                                   KSWHKSW+1
                                                                                                                                        F (M-4)
                                                                                       CONTINUE
                                                                                                                                                 IPAGE=8
                                                                                                          IPAGE=1
                                                                                                                                                                     IPAGE=7
                                                                                                                              JFLG=2
K=N(L)
                                                                                                                                                                                                                       JFLG=2
                                                                                                                                                                                         60 10
                                                                                                                                                                                                             GO TO
                                                                                                                                                                               WRITE
                                                                                                                                                                                                  KRITE
                                                                                                                                                                                                                                WRITE
                                                                                                                                                                                                                                                                                                                                 60 10
                                                                                                                                                                                                                                                                                                                                            GO TO:
                                                                                                                                                                                                                                                                                                                                                                GO TO
                                                                                                                                                                                                                                                                                                                                                                                  WRITE
                                                                                                                                                                                                                                                                                                                                                                                             GO TO
                                                                                                                                                                                                                                                                                                                                                                                                      WRITE
                                                                                                                                                                                                                                                                                                                                                                                                                                   WRITE
                                                                                                                                                                                                                                                                                                                      WRITE
                                                                                                                                                                                                                                                                                                                                                                         WRITE
                   KSW=0
                                                                                                                                                                                                                                                   WRITE
                                                                                                                                                                                                                                                            WRITE
                                                                                                                                                                                                                                                                                         WRITE
                                                                                                                                                                                                                                                                                                                                                     WRITE
                                                                                                                                                                                                                                          WRITE
                                                                                                                                                                                                                                                                                WRITE
                                                                                                                                                                                                                                                                                                   WRITE
                                                                                                                                                                                                                                                                                                            WRITE
                                                                                                                                                                                                                                                                     WRITI
                                                                                                           200
                                                                                                                                                  215
                                                                                                                                                                     220
                                                                                                                                                                              230
                                                                                                                                                                                                                                          135
                                                                                       165
                                                                                                                               210
                                                                                                                                                                                                   115
                                                                                                                                                                                                                      781
                                                                                                                                                                                                                                                                                                                                                                                                                          119
                                                                    160
                                                                                                                                                                                                                                                                                                                                                                         138
                                                                                                                                                                                                                                                                                                                                                                                                      118
                                                                                                                                                                                                                                                                                                                                                     37
```

```
OUTP1132
OUTP1133
                                                                                                WRITE (3,19) (I,REA(L,1),AD1(L,1),X(L,1),Y(L,1),Z(L,1),COE(L,1,1),I),OUTPT141
1COE(L,2,1),CLEAR(L,1),ARS(L,1),TCRS(L,1),SECON(L,1),SOLID(L,1),I=10UTPT142
                                                                                                                                             OUTPT145
                                         CUTPT136
                                                                                                                      OUTPI143
                                                                                                                                  OUTP1144
                   OUTPT134
                              CUTPIL35
                                                    OUTPT137
                                                               CUTPT138
                                                                          OUTPT139
                                                                                     OUTP1140
                                             WRITE (3,40) (NSW(1),1=1,KSW)
   STRL(L), RHO(L), M
                       WRITE (3,42) (
IF (KSW) 128,128,125
                                                                                                                                      GO TO (134,150), JFLG
                                                                                                                                                                                OUTPT
   (3,38)
                                                                                                                                                                                  Y
Y
                                                                   (3,41)
                                                                             (3,18)
                                                                                        (3,21)
                                                        131
                                                                                                                                                                                 S×
                                                                                                                                                                                            A
                                                                                                                                                RETURN
                                                                   WRITE
                                                                              WRITE
                                                                                        WRITE
                                                                                                                                                           END
                                                                                                                                                                      // DUP
*STORE
*DUMP
                                                                                                                                                 150
                        130
                                              125
                                                                    128
```

et Newby that is	British and					
P100	P100 P100 P100		1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 O 1 P 1 P		TP103 TP103 TP103	00171034 00171035 2 00171035 500171037 00171039 00171039 00171040 00171041
PT STRESS AND	PTI(2),UM1(2), TST,ETTT,ETSTM, RTT(2),UMS,SUMHT(2) KFLAG,MFLAG,LFLAG,L	GE, EMACH 2,10), PRSQL, PI NI, PMANI, VUZ(10), VXZ(1),PT1(10),PT2(10), VU1T(10),AD1T(10), 2T(10),V2T(10), 10),VU1H(10),AD1H(1, D2H(10),V2H(10),	10), PZH(10), AC1T(10), PZH(10), TZT((10), VXH(10) T(10), PTZH(10),	ARS(2,10),TCRS(2,10),T	VU1 . VX1 WU2 WU2 FT/SEC FT/SEC X*11F9*1*F9*3//) AGE GEOMETRY,46X,
ED INFORMATION EXCE	IS.SHP(2).W.TTI(2). PRSTM(2).PRTTM(2).E 2).RES(2).PRST(2).P .CASE1.CASE2.JFLAG.	ECE, PECE, RFACT, IP 2,10), Z(2,10), AD1 T, UCOTM, AREA! 0), BMACH, INPAR, TM 0), WU1(10), VZ(10)	10) PRS(10) PRN(1 10) H2(10) UT(10) 1T(10) VU2T(10) A T(10) REAT(10) CH	KEAH(10) * 11(10) * 12(10) * 1	<pre>.m, kHO(2); NF LAG; W .2,10); CLEAR(2,10) ID(2,10); DELTA(2) 2,1H-,A2,39X,16HS</pre>	VU2 VU2 VX2 VX2 FT/SEC FT/SEC FT/SEC FT/SEC FT/SEC F1
OUTP1 INTS ALL CALCULAT FORMATION	1D,1Y,R,GAM,CP,V 2),DHO(2),SP(2), 2),UCO,UCOM,RET(14. PRSMM. PRTMM. 2.10). Y.(2.10). REAF. 2.10). Y.(2.10). REAF. 3L. UCSOL. UCTOL. UC. (10). PAS(10). DHS(10). W1(10).	1(10), T12(10), PRT N1(10), H1(10), AN2 N1T(10), 8D1T(10), PT(10), BD2T(10), W WUH(10), BD1H(10)	3D2H(10),WZH(10), [10),RMF[10),ACI([1H(10),T1T(10),T DT(10),VEP(10),DV 2H(10),RMA(10),TT PTH(10),TTL1(20	JMI, PII, PRSI, 15 10), STRT(10), COE(10), ARCON(2,3), SO 41) 7/5H DATE, AZ, 1H-,	//) U1 W1 119H N /113H T/SEC FT/SEC X,12,1X,11F9,1,F9 //5H DATE,A2,1H-, //) 120H STAG S ANNULUS
// FOR SUBROUTINE C SUBROUTINE PRI	COMMON IM 1COEM(2),N 2ETTTM,UMA 3SUMHS(2),	PROOS PR ETSMM = ET COMMON X ETSOL = ET COMMON U	WZ 110) * WZ (10) * TPT0(10) * V1T(10) * COMMON W	WUZH(10) CS(10)•L ACZT(10) PZT(10) COMMON V PT1T(10)	TRL(2). 5).STRE SECON(2 SET(10) DRMAT (14HPAGE • 13 27 FORMAT (2V1 3 REACTIO 47/SEC F 19 FORMAT (5 7 FORMAT (7 14HPAGE • 13 29 FORMAT (

```
OUTP1044
OUTP1045
                                                                                                                                                                                                                                                                                                                                                                                                            OUTP1069
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP1074
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         OUTP1075
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         2V1(I), WU1(I), W1(I), VU2(I), VX2(I), V2(I), WU2(I), W2(I), REA(L, I), UT(I)OUTP1680
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1082
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP1083
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1084
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP1085
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP1086
                             OUTP1046
                                                             OUTP1048
                                                                            OUTP1049
                                                                                                                                                                                                                                            0UTP1059
                                                                                                                                                                                                                                                                                                             OUTP1063
                                                                                                                                                                                                                                                                                                                            OUTP1064
                                                                                                                                                                                                                                                                                                                                            OUTP1065
                                                                                                                                                                                                                                                                                                                                                                                            OUTP1058
                                                                                                                                                                                                                                                                                                                                                                                                                             OUTP1070
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1073
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           0UTP1076
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP1078
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          •OUTP1079
                                           OUTP1047
                                                                                             OUTP1050
                                                                                                                             OUTP1052
                                                                                                                                           OUTP1053
                                                                                                                                                                            T10UTP1055
                                                                                                                                                                                             OUTP1056
                                                                                                                                                                                                            0UTP1057
                                                                                                                                                                                                                            PSIOUTP1058
                                                                                                                                                                                                                                                             OUTP1060
                                                                                                                                                                                                                                                                                          11 FORMAT (///5H DATE, A2, 1H-, A2, 1H-, A2, 38X, 18HSTAGE MACH NUMBERS, 44X, OUTP1062
                                                                                                                                                                                                                                                                                                                                                            OUTP1056
                                                                                                                                                                                                                                                                                                                                                                            OUTP1067
                                                                                                              OUTP1051
                                                                                                                                                            OUTP1054
                                                                                                                                                                                                                                                                             OUTP1061
                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1071
                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1072
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP1081
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP108
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP107
                             AREA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          IVU2H(I),VX2H(I),V2H(I),WU2H(I),W2H(I),REAH(I),UM(I),VUI(I),VXI(I)
                                            Z
                                                                                                                                                                                                                                            DEG R/(7x,12,1x,4F10.1,30x,4F10,1/10x,4F10.1,2F10.3,
                                                                                                                                                                                                                                                                                                                                            ROTOR EXIT/(7X,12,8X,F5,3,F15,3/17X,F5,3,F15,3/
                                                                                                                                                             7
                                                                                                                                                                                                                                                                                                                             RELATIVE /10X,30H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           3,VULT(I),VX1T(I),V1T(I),WULT(I),WLT(I),VUZT(I),VXZT(I),VZT(I),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (I,UH(I),VUIH(I),VXIH(I),VIH(I),WUIH(I),WIH(I),
                                                                                             22 FORMAT (9X,12,1X,F12,4,F10,3,2X,F10,3,2X,2F12,3,4F12,2/72X
                                                                                                                                                                                                                              PSIA
                                                                                                                             8 FORMAT (///5H DATE, A2, 1H-, A2, 1H-, A2, 17X, 9HPRESSURES, 55X,
                             HE I GHT
                                                                                                                                                                                                                               PSIA
                                                                                                                                                             STAGE
                             HE I GHT
                                                                                                                                                                               PRT
                                                                                                                                                                                                                                                                                                                              ABSOLUTE
                                                                                                                                                                                                                                                                             610X,4F10.1/10X,4F10.1,30X,4F10.1//))
                                                                                                                                                                                                                                                                                                                                                                                              (51X, 18HNON TWISTED BLADES//)
                                                                                                                                                               120H
                              RADIUS
                                                                                                                                              112HTEMPERATURES, 7X, 4HPAGE, 13/7)
                                                                                                                                                                                                                                                                                                                                                                              (54X,11HFREE VORTEX//)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             4WU2T(I); W2T(I); REAT(I); I=1;K)
                                                                                                                                                                                                                                120H
                                                                                                                                                                                PRS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              WRITE (3,11) IM, ID, IY, IPAGE
                                                                                                                                                                                                                                                                                                                                                                                                                                                               WRITE (3,6) IM, ID, IY, IPAGE
                                                                SO-IN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                               IF (IFLAG-2) 40,50,50
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             65,70,70
                                                                                                                14F12.2/72X,4F12.2//)
                                              AREA 2/120H
                                                                                                                                                                                                                                                                                                                                                                317X9F5.39F15.3//))
                                                                                                                                                                                 <u>م</u>
                                                                                                                                                                                                                                                                                                                                 40H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              IPAGE=IPAGE+1
                                                                                                                                                                                                                                                                                                                                                                                                                                                IPAGE=IPAGE+1
                                                                SQ-1N
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (3,19)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (3,26)
                                                                                                                                                                                                                                                                                                                 14HPAGE • I3//)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            WRITE (3,25)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              (3,27)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              F (IFLAG-2)
                                                                                                                                                                                                                                                                                                                                                                                                                                WRITE (3,3)
                                                                                                                                                                                                                                                                                                                                                EXIT
                                                                                                                                                                                                                                                  PSIA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               WRITE (3,3)
                                                                                                                                                               30 FORMAT
                                                                                                                                                                                                                                                                                                                                                2NOZZLE
                                                                                                                                                                                                                                                                                                                                                                               25 FORMAT
                                                                                                                                                                                                                23 FORMAT
                                                                                                                                                                                                                                                                                                                                                                                               FORMAT
                                                                                                                                                                                                                                                               5 DEG R
                                                                                                                                                                                                                                                                                                                                28 FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              WRITE
                                                                                                                                                                                                                                                                                                                                                                                                                K=N(L)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              WRITE
                                                                               6 DEG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              60
                                               77
                                                                                                                                                                                                                                  m
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                20
```

```
OUTP1115
OUTP1088
            OUTP1089
                                                                                                                                     0UTP:1099
                                                                                                                                                 OUTP1100
                                                                                                                                                                          OUTP1102
                                                                                                                                                                                      OUTP1103
                                                                                                                                                                                                  OUTP1104
                                                                                                                                                                                                              OUTP1105
                                                                                                                                                                                                                          OUTP1106
                                                                                                                                                                                                                                      OUTP1107
                                                                                                                                                                                                                                                 OUTP1108
                                                                                                                                                                                                                                                             OUTP1109
                                                                                                                                                                                                                                                                                                                                                 OUTP1116
                        OUTP1090
                                                OUTP1092
                                                             OUTP1093
                                                                        OUTP1094
                                                                                     OUTP1095
                                                                                                 OUTP1096
                                                                                                                        0UTP1098
                                                                                                                                                                                                                                                                          OUTP1110
                                                                                                            0UTP1097
                                                                                                                                                             OUTP1101
                                    0UTP1091
                                                                                                                                                                                                                                                                                                                                                                OUTP1117
                                                                                                                                                                                                                                                                                                                         OUTP111
                                                                                                                                                                                                                                                                                      OUTPILL
                                                                                                                                                                                                                                                                                                  OUTP111
                                                                                                                                                                                                                                                                                                             OUTPIII
                                                                                                                                                                                                                                                                                                                                    2TT1(1),T1(1),TT2(1),T2(1),PT1T(1),P1T(1),PT2T(1),P2T(1),T11(1),
                                                                                                                                                                                                                                                                                                              (I,PT1H(I),P1H(I),PT2H(I);P2H(I),TT1(I)
                                                                                                                                                                                                                                                                                                                          171H(I),TT2H(I),T2H(I),PT1(I),P1(I),PT2(I),P2(I),PRS(I),PRT(I),
                                                                                                                                                                                      IAD2H(I), BD2H(I), AD1(L, I), BD1(I), AD2(I), BD2(I), ADIT(I), BD1T(I),
                         (I, AC1H(I), AC2H(I), AC1(I), AC2(I),
                                                                                                                                                             (I + RMF(I) + H1(I) + H2(I) + AN1(I) + AN2(I) +
                                                                                                                                                                                                                                                                                                                                                    3T1T(I) * TT2T(I) * T2T(I) * I=1*K)
                                                                                                                                                                                                                                        WRITE (3,8) IM, ID, IY, IPAGE
                                                                          WRITE (3,7) IM, ID, IY, IPAGE
                                                                                                                                                                                                                                                     95,100,100
                                                                                                                                                                                                   2AD2T(I), BD2T(I), I=1,K)
                                      1AC1T(1) • AC2T(1) • 1=1 • K)
                                                                                      80,85,85
                                                                                                                                                                                                                                                                                                                                                                                                     OUTP1
                                                                                                                                                                                                                                                                                                                                                                                                                  OUTP1
                                                                                                                                                                            ADIH(I), BDIH(I);
                                                                                                                                                                                                                             IPAGE = IPAGE + 1
                                                               IPAGE=IPAGE+1
                                                                                                                                                                                                                                                                                                                                                                                                        A O
                                                                                                                                                                                                                                                     (IFLAG-2)
                                                                                                                                                                                                                                                                                                               (3,23)
              3,261
                         (3,28)
                                                                                      (IFLAG-2)
                                                                                                                                                  3,21)
                                                                                                                                                               3,22)
                                                                                                                                                                                                                                                                                                     3,30)
                                                                                                  (3,25)
                                                                                                                           3,261
                                                                                                                                      3,291
                                                                                                                                                                                                                                                                WRITE (3,25)
                                                                                                                                                                                                                                                                                          3,261
                                                   WRITE (3,3)
                                                                                                                                                                                                                 (3,3)
                                                                                                                                                                                                                                                                            105
                                                                                                                                                                                                                                                                                                                                                                                                      × N
N
N
N
                                                                                                               06
                                                                                                                                                                                                                                                                                                                                                                   RETURN
                                                                                                   WRITE
                                                                                                                                                 WRITE
                                                                                                                                                                                                                                                                             60 10
                                                                                                                                                                                                                 WRITE
              WRITE
                          WRITE
                                                                                                                                                                                                                                                                                         WRITE
                                                                                                               60 70
                                                                                                                          WRITE
                                                                                                                                      WRITE
                                                                                                                                                               WRITE
                                                                                                                                                                                                                                                                                                     WRITE
                                                                                                                                                                                                                                                                                                                 WRITE
                                                                                                                                                                                                                                                                                                                                                                               END
  09
                                                                                      <u>|</u>
                                                                                                                                                                                                                                                                                                                                                                                          // DUP
                                                                                                                                                                                                                                                                                                                                                                                                      *STORE
              70
                         75
                                                                                                                                                                                                                                                                                          100
                                                                                                                                                                                                                                                                                                     105
                                                                                                                                                                                                                                                                                                                                                                                                                 dWNQ*
                                                                                                                           85
                                                                                                    08
                                                                                                                                      06
                                                                                                                                                                                                                                                                 95
```

```
3 FORMAI (3X,12,11X,F7,4,15X,F5,3,13X,F5,1,13X,F8,1,12X,F7,1,8X,F8,10UTP2038
                                                                                                                                                                                                                                                                                                                                                                                                 2 FORMAT (2X, STAGE +, 11X, MEAN +, 14X, AVERAGE +, 13X, STAGE +, 11X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                                                             3'STRESS'/19X,'IN',17X,'IN',15X,'PERCENT',14X,'PSI',16X, PSI',13X,
                                                                                                                                                                                                                                                                                                                 2'BLADE HEIGHT',11X, LOAD',15X, STRESS',13X, STRESS',10X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  310) .STRB(10) .STRT(10) .COE(2,2,10) .CLEAR(2,10) .ARS(2,10) .TCRS(2,10)OUTP2028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           3CS(10) *UC(10) *RMF(10) *AC1(10) *AC2(10) *AC1H(10) *AC2H(10) *AC1T(10) *
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          5V1T(10), WU1T(10), BD1T(10), W1T(10), VU2T(10), AD2T(10), V2T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      4PTO(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   2W2(10),WU2(10),BD1(10),AD2(10),BD2(10),ETS(10),ETT(10),E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   3SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       ZETTTM.UMA(2), UCO.UCOM.RET(2).RES(2).PRST(2).PRTT(2).UMS.SUMHT(2).
                                 202HBLADE. THE ABOVE STRESS VALUES ARE AT A PRESSURE RATIO OF 4.0.0UTP2042
                                                                          10 ARRIVE AT A STRESS
                                                                                                                                                                                                                                                                                                                                                                                                                                          142X,4HPAGE, 13 ///)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              4.SECON(2.10).ARCON(2.3).SOLID(2.10).DELTA(2).OSF(2).OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             2STRL(2), TUM1, TPTI, TPRST, TSP, M, RHO(2), NFLAG, WF(10), HAVE(10), STRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               1PT1T(10),PT1H(10),TITL1(20),TITL2(20),TITL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       2WU2H(10),BD2H(10),W2H(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           1,V1H(10),WU1H(10),BD1H(10),W1H(10),VU2H(10),AD2H(10),V2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1V1(10),VU1(10),VX1(10),W1(10),WU1(10),V2(10),VU2(10),VX2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    SETSMM.ETTMM.PTME(2).AREAF.TECE.PECE.RFACT.IPAGE.EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              1COEM(2),N(2),DHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT,ETSTM,
                                                                                                                                                                                                                                                                                                                                                        1 CENTRIPETAL . 10X, BENDING . 10X, TOTAL . / 17X, RADIUS . 10X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    1ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREA!
                                                                                                                        FORMAT (//2X,80HNOTE,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   FORMAT(///5H DATE + A2 + 1H - + A2 + 1H - + A2 + 35 X + 23 HROTOR BLADE ROOT STRESS + OUTP 203
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        COMMON VX2H(10) .RMA(10) .TT2T(10) .TT2H(10) .PT2T(10) .PT2H(10).
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    COMMON WUZT(10) .BD2T(10) .WZT(10) .REAT(10) .UH(10) .VU1H(10) .AD1H(10) OUTP2019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           COMMON X(2,10), Y(2,10), REA(2,10), Z(2,10), ADI(2,10), PRSOL, PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 SUBROUTINE OUTP2
MINIMUM STRESS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         PRINTS CALCULATED STRESS DATA
  IS AT A PRESSURE RATIO/9X,21HOF APPROXIMATELY 4.00UTP2043
                                                                             VALUE OF .F7.1,22H PSI IN THE LAST ROTOR/9X,10UTP2041
                                                                                                                      TURBINE PRESSURE
                                                                                                                          RATIO CANNOT BE ADJUSTED
                                                                                                                             TOUTP2040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     OUTP202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      OUTP2008
                                                                                                                                                                                                                                                                                     OUTP2036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               0UTP202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OUTP2007
                                                                                                                                                                                                                                                                                                                           OUTP2035
                                                                                                                                                                                                                                                                                                                                                                    OUTP2034
                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTP2032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTP2030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP2026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        OUTP2024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              OUTP202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     OUTP202
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTP20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OUTP20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 OUTP2009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        OUTP2006
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              OUTP200
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OUTP2004
                                                                                                                                                                                                                                                                                                                                                                                                        OUTP2033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     OUTP20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP2012
```

*STORE WS	4.) 6 FORMAT (7/2x 1ROUTINE EXCE 15 FORMAT (1H1) K=N(L) WRITE (3.15) IPAGE=IPAGE+ WRITE (3.2) WRITE (3.2) WRITE (3.3)(1STRT(1).I=1. GO TO (10.10) 5 WRITE (3.4) GO TO 10 7 WRITE (3.6) 10 RETURN END
UA OUTP2 CD OUTP2	(//2x,103HNOTE, NUMBER OF ITERATIONS THROUGH THE EXCEEDED 15 WITHOUT REACHING THE STRESS LIMIT.) (1H1) (3,15)
	NUMBER OF INTHOUT REACHINGE PAGE PAGE NONFLAG
	GERATIONS THROUGH THE
	B (1)
	SS SUBOUTP2044 OUTP2046 OUTP2046 OUTP2047 OUTP2048 OUTP2050 OUTP2051 OUTP2053 OUTP2054 OUTP2055 OUTP2056 OUTP2056 OUTP2056 OUTP2056 OUTP2058 OUTP2058

```
A0UTP3036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  DEG R//F10.2.F10.3.0UTP3038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            4 FORMAT (//Z6X • 68HOVERALL TURBINE PERFORMANCE INCLUDING MANIFOLD ANOUTP3040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       COMMON WU2T(10),BD2T(10),W2T(10),REAT(10),UH(10),VU1H(10),AD1H(10)OUTP3020
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            OUTP3025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           OUTP3026
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       OUTP3028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)0UTP3029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          OUTP3033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       OUTP3035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5 FORMAT 1//32X•55HOVERALL TURBINE PERFORMANCE INCLUDING EXHAUST COLOUTP3043
                          OUTP3002
                                                     OUTP3003
                                                                                                                     0UTP3005
                                                                                                                                                  0UTP3006
                                                                                                                                                                              OUTP3007
                                                                                                                                                                                                                OUTP3008
                                                                                                                                                                                                                                              0UTP3009
                                                                                                                                                                                                                                                                             OUTP3010
                                                                                                                                                                                                                                                                                                                                       DUTP3012
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    OUTP3022
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    OUTP3023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  0UTP3024
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       OUTP3027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              0UTP3032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           0UTP3034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   SQ-0UTP3037
DUTP3001
                                                                                           00TP3004
                                                                                                                                                                                                                                                                                                         OUTP3011
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      OUTP3021
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              OUTP3031
                                                                                                                                                                                                                                                                                                                                                                                                    OUTP301
                                                                                                                                                                                                                                                                                                                                                                       OUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                  OUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                DUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              OUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             OUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         OUTP301
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PSIA
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             MACH
                                                                                                                                                                                                                                              35UMHS(2),PREQS,PREQT,IFLAG,CASE1,CASE2,JFLAG,KFLAG,MFLAG,LFLAG,L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    3CS(10);UC(10);RMF(10);AC1(10);AC2(10);AC1H(10);AC2H(10);AC1T(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       STRL(2),TUM1,TPT1,TPRST,TSP,M,RHQ(2),NFLAG,WF(10),HAVE(10),STRC(
                                                                                                                                                                                                            PETITIM, UMA(2), UCO, UCOM, REI(2), RES(2), PRSI(2), PRTI(2), UMS, SUMHI(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ZWUZH(10), BD2H(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10),
                                                                                                                                                                                                                                                                                                                                         COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),ADI(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           4PT0(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                              ZWZ(10), WUZ(10), BD1(10), ADZ(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      1.*V1H(10),*WU1H(10),*BD1H(10),*W1H(10),*VU2H(10),*AD2H(10),*V2H(10),*
                                                                                                                                                                                                                                                                                                                                                                                                                                |VI(10),VUI(10),VXI(10),WI(10),WUI(10),V2(10),VU2(10),VX2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     2 DEG-R PSIA / F10.2.F10.3.3F10.1)
2 FORMAT (40X,40HEXHAUST COLLECTOR EXIT FLANGE CONDITIONS//60H
                                                       DATA FOR EACH STAGE AND
                                                                                                                                                                                [COEM(2),N(2),DHO(2),SP(2),PRSTM(2),PRTTM(2),ETST,ETTT,ETSTM,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4, SECON(2,10), ARCON(2,3), SOLID(2,10), DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5V1T(10), WULT(10), BDLT(10), WLT(10), VUZT(10), ADZT(10), VZT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2H(10)
                                                                                                                                                  COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UM1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     160H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                                                                                                                                                                                                                                                                                                                                                      COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                                                                                           SETSMM, ETTMM, PTME (2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           PILI(10), PT1H(10), TITL1(20), TITL2(20), TITL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             1 FORMAT (//47X, 25HINLET MANIFOLD CONDITIONS//50H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    \alpha
                                                                                                                                                                                                                                                                                                                                                                        ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                         SUBROUTINE PRINTS CALCULATED PERFORMANCE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           PTME /50H
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ETTT /6F10.31
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 1D EXHAUST COLLECTOR///60H
                                                                                                                                                                                                                                                                               4PRGOS, PRGOT, PRSMM, PRTMM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            5
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            MACH NUM
       SUBROUTINE OUTP3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         FORMAT (1H1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        34F10.1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         5,RT(10)
                                                                                                EACH SPOOL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              IREA
```

```
UMOUTP3049
                                                                                                                                                             OUTP3055
                                                                                                                                                                                                                                      OUTP3060
                                                                                                                                                                                                                                                                                                               OUTP3065
                                                                                                                                                                                                                                                                                                                               OUTP3066
                                                                                                                                                                                                                                                                                                                                                            OUTP3068
                                                                                                                                                                                                                                                                                                                                                                        OUTP3069
                                                                                                                                                                                                                                                                                                                                                                                      OUTP3070
                                                                                                                                                                                                                                                                                                                                                                                                                  OUTP3072
             OUTP3045
                                         OUTP3047
                                                        OUTP3048
                                                                                    OUTP3050
                                                                                                                 OUTP3052
                                                                                                                               OUTP3053
                                                                                                                                               0UTP3054
                                                                                                                                                                            OUTP3056
                                                                                                                                                                                                          OUTP3058
                                                                                                                                                                                                                        OUTP3059
                                                                                                                                                                                                                                                                    OUTP3062
                                                                                                                                                                                                                                                                                   OUTP3063
                                                                                                                                                                                                                                                                                                  OUTP3064
                                                                                                                                                                                                                                                                                                                                            OUTP3067
                                                                                                    OUTP3051
                                                                                                                                                                                           0UTP3057
                                                                                                                                                                                                                                                      0UTP3061
                                                                                                                                                                                                                                                                                                                                                                                                    OUTP3071
                           9 FORMAT (///5H DATE, A2, 1H-, A2, 1H-, A2, 38X, 17HSTAGE PERFORMANCE, 45X, 14HPAGE, 13///60H STAGE ETT
                                                                                                                 TURBINE PERFORMANCE INCLUDING MANIFOLD/
                                                                                                                                                                                                          WRITE (3,9) IM, ID, IY, IPAGE, (I, PAS(I), DHS(I), ETS(I), ETT(I), UC(I),
                                                                                                                                 3,10) DHO(L),UMA(L),UCO,UCOT,PRST(L),PRTT(L),ETST,ETTT,
ETST
                                                                         DEL
                                                                                                   FT/SEC/2F10.1,8F10.3)
                                                       U/CO /24X;6HBTU/LB/(7X;12;1X;F10.3;F10.1;3F10.3/))
                                                                                                                                                                                                                                                                                   (3,12) UCOM, UCOTM, PRSTM(L), PRTTM(L), ETSTM, ETTTM
                                                                                      ETST
                                                                                                                                 ETSL
                                                                                                                                                                                                                                                                                                                3,5) UCOM, UCOTM, PRSTM(L), PRTTM(L), ETSTM, ETTTM
PRTT
                                                                       10 FORMAT (//47X,25HOVERALL BLADE PERFORMANCE///100H
                                                                                                                                                                                                                                                                                                                                                                                                      AREAF, EMACH, PTME(2), PECE, TT2(K), TECE
                                                                                                                                                                                                                                                                                                                                              3,4) UCSOL,UCTOL,PRSOL,PRTOL,ETSOL,ETTOL
                                                                                                                                                                                                                                                                                                                                                                         AREAL , BMACH , PMANI , TMANI , PTME (1)
PRST
                                                                                                                                 PRST
                                                                                                     BTU/LB
                                                                                                                    (1/37X,46HOVERALL
                                                                                                     RES /20H
                                                                                                                                                                                                                                                                                                                                                                                          155,150), LFLAG
                                                                                                                                                                                                                                                                                                                                  125,150),LFLAG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   OUTP3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                OUTP3
                                                                                                                                                                                                                                                                       130,1351,1
                                                                                                                                                                                                                                                                                                                                                              151,152),1
                  ETTT /6F10.3)
                                                                                                                                                                                                                                                         LRET(L), RES(L)
                                                                                                                                                                                               IPAGE=IPAGE+1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Y
O
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                00
                                                                                         00/0
   1LECTOR///60H
                                                                                                                                                                               WRITE (3,3)
                                                                                                                                                                                                                                                                                                      140
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Y
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    S)
                                                                                                                     12 FORMAT
                                                                                                                                                  26F10.3
                                                                                                                                                                                                                                                                                                                                                                                                                      RETURN
                                                                                                                                                                                                                                          WRITE
                                                                                                                                                                 K=N(L)
                                                                                                                                                                                                                             11 = 1.0
                                                                                                                                                                                                                                                                       GO TO
                                                                                                                                                                                                                                                                                      WRITE
                                                                                                                                                                                                                                                                                                                                   G0 T0
                                                                                                                                                                                                                                                                                                                                                WRITE
                                                                                                                                                                                                                                                                                                                                                                                          GO TO
                                                                                                                                                                                                                                                                                                                                                                                                         WRITE
                                                                                                                                                                                                                                                                                                      GO T
                                                                                                                                                                                                                                                                                                                   WRIT
                                                                                                                                                                                                                                                                                                                                                               GO T
                                                                                                                                                                                                                                                                                                                                                                             FINE F
                                                                                                                                                                                                                                                                                                                                                                                                                                       END
                                                                                                                                                                                                                                                                                                                                                                                                                                                     dna //
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  *STORE
                                                                                                                                                                                                                                                                                                                                                                                                         155
                                                                                                                                                                                                                                                                                                                                                                                                                        160
                                                                                                                                                                                                                                                                                                                                                               40
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  *DOMP
```

```
PRAT0005
                                                                                                                                                                                                                     PRATO008
                                                                                                                                                                                                                                                PRAT0009
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PRAT0029
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          PRAT0035
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       PRAT0036
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                PRAT0038
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             PRAT0039
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    PRAT0.040
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             PEAT0042
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          PRAT0043
                                                 PRAT0002
                                                                         PRAT0003
                                                                                                        PRAT0004
                                                                                                                                                            PRAT0006
                                                                                                                                                                                         PRAT0007
                                                                                                                                                                                                                                                                           PRATC010
                                                                                                                                                                                                                                                                                                                                                               PRATO013
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          PRAT0025
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PRAT00:26
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          PRAT0028
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  PRAT0030
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          PRAT0032
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PRAT0033
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               PRAT0034
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PRAT0041
                      PRATODOL
                                                                                                                                                                                                                                                                                                        PRATO011
                                                                                                                                                                                                                                                                                                                                  PRATO012
                                                                                                                                                                                                                                                                                                                                                                                                                                                 PRATO016
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PRATO023
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                PRAT0027
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            PRAT0031
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 PRAT0037
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    PRATO019
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            PRATO02
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        PRATO02
                                                                                                                                                                                                                                                                                                                                                                                                                     PRAT001
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               COMMON WUZT(10), BD2T(10), WZT(10), REAT(10), UH(10), VU1H(10), AD1H(10) PRATG02
                                                                                                                                                                                                                                                                                                                                                                                          PRATO01
                                                                                                                                                                                                                                                                                                                                                                                                                                                                               PRATO01
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              PRAT002
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       PRATO01
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)
                                                                                                                                                                                                                                             SUMHS(2), PREOS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                                                                                     ETTIM, UMA(2), UCO, UCOM, RET(2), RES(2), PRST(2), PRTT(2), UMS, SUMHT(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC1T(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           STRL(2),TUMI,TPTI,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),STRC
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              3RM(10),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       4PT0(10),AN1(10),H1(10),AN2(10),H2(10),UT(10),VU1T(10),AD1T(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ZWUZH(10),8DZH(10),WZH(10),REAH(10),T1(10),T2(10),P1(10),P2(10),
                                                                                                                                                                                                                                                                                                                                  COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL
                                                                                                                                                                                                                                                                                                                                                                                                                                               2W2(10),WU2(10),BD1(10),AD2(10),BD2(10),ETS(10),ETT(10),E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                     V1(10),VU1(10),VX1(10),W1(10),WU1(10),V2(10),VU2(10),VX2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            *V1H(10);WU1H(10);BD1H(10);W1H(10);VU2H(10);AD2H(10);V2H(10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                W=550.*SHP(1)/(ETTTM*778.16*CP*TTI(1)*(1.--(1./PREQT)**CON4))
                                                                                                                                                                                         COEM(2), N(2), DHO(2), SP(2), PRSTM(2), PRTTM(2), ETST, ETTT, ETSTM;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                4.SECON(2.10).ARCON(2.3).SOLID(2.10).DELTA(2).OSF(2).OSEXP(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 W=550.*SHP(1)/(ETSTM*778.16*CP*TTI(1)*(1.-(1./PREQS)**CON4))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    5V1T(10) • WULT(10) • BDLT(10) • WLT(10) • VU2T(10) • AD2T(10) • V2T(10)
                                                                                                                                                            COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TII(2), PTI(2), UM1(2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        5P2T(10),COT(10),VEP(10),DVU(10),VX1T(10),VX2T(10),VX1H(10)
                                                                            RATIO
                                                                                                                                                                                                                                                                                                                                                                                             COMMON UM(10).PAS(10).DHS(10).BMACH.INPAR,TMANI,PMANI.
                                                                                                                                                                                                                                                                                                          ETSMM, ETTMM, PIME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                         SATISFY PRESSURE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              PT11(10), PT1H(10), TTL1(20), TTLL2(20), TTLL3(20),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        IF (ABS(PRTTM(1)-PREQT)-0.01) 100:100:75
                                                                                                                                                                                                                                                                                                                                                                ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           IF(ABS(PRSTM(1)-PREOS)-0.01) 100,100,65
                                                                            0
                                                                            RATE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  TO (60,70,80,90,100), MFLG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              GO TO (60,70,82,92,100), MFLG
                           SUBROUTINE PRATO (MFLG,JK,K)
                                                                            NEW FLOW
                                                                                                                                                                                                                                                                               4PROOS, PROOT, PRSMM, PRTMM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         IF (LFLAG-1) 50,50,40
                                                                            SUBROUTINE CALCULATES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CON4 = (GAM-1 • ) / GAM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             GO TO 150
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 150
                                                                                                             REGUIREMENT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      JK=1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       した。」
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      09
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 09
FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            09
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               0/
```

```
PRATO045
                                                      PRATCO49
                                                                                                                        PRAT0055
                                                                                                                                                                              PRAT0050
                                                                                                                                                                                                                                                 PRATCO66
                                                                                                                                                                                                                                                                      PRATO068
                                                                                                                                                                                                                                                                                 PRAT0069
                                                                                                                                                                                                                                                                                           PRATO070
                                                                                                                                                                                                                                                                                                                 PRAT0072
                                                                                                                                                                                                                                                                                                                            PRAT0073
                                                                                                                                                                                                                                                                                                                                        PRAT0074
                                                                                                                                                                                                                                                                                                                                                  PRAT0075
                                                                                                                                                                                                                                                                                                                                                             PRAT0076
PRAT0044
                     PRAT0046
                                           PRAT0048
                                                                PRATC050
                                                                                                             PRAT0054
                                                                                                                                   PRA.T0056
                                                                                                                                                         PRAT0058
                                                                                                                                                                   PRATC059
                                                                                                                                                                                                                           PRA T0064
                                                                                                                                                                                                                                     PRATO065
                               PRAT0047
                                                                                      PRAT0052
                                                                                                  PRAT0053
                                                                                                                                              PRAT0057
                                                                                                                                                                                         PRATC061
                                                                                                                                                                                                     PRAT0062
                                                                                                                                                                                                                PRAT0063
                                                                                                                                                                                                                                                                                                      PRAT0071
                                                                           PRATC051
                                                                                                                                                                                                                                                           PRATO057
                                                                                                                                                                                                                                     W=550.*(SHP(1)+SHP(2))/(ETTMM*778.16*CP*TTI(1)*(1.-(1./PROOT)
                                                                                      W=550.*(SHP(1)+SHP(2))/(ETSMM*778.16*CP*TTI(1)*(1.-(1./PROOS)
                                                                                                                                                                                                                            96, 96,95
                                                                                                                                                                                           UM1(2)=SP(2)*3.14159*RM(K)*RFACT/30.
                                           UM1(2)=SP(2)*3.14159*RM(K)*RFACT/30.
                                                                             IF (ARS(PRSMM-PROOS)-0.01) 96,96,85
                                                                                                                                                                                                                             IF (ABS (PRTMM-PROOT)-0.01)
                                                                                                                                                                                                                                                                                             (LFLAG-1) 100,100,97
                                                                                                                                                                                                                                                                                                                                                                                                   PRATO
PRATO
                                                                                                                                                IF (L-1) 91,91,92
  81,81,82
                       TTI(2)=TT2(K)
PTI(2)=PT2(K)
                                                                                                                                                                      TI(2) = TT2(K)
                                                                                                                                                                                PTI(2)=PT2(K)
                                                                                                                                                                                                                                                                                                                                                                                                     ٧
                                                                  GO TO 150
                                                                                                                                                                                                                  TO 150
                                                                                                                                                                                                                                                                                   GO TO 150
                                                                                                                                     GO TO 150
                                                                                                                                                                                                                                                                                                                                           GO TO 150
                                                                                                                                                                                                                                                                                                                                                                                                     S
                                                                                                    (( $NOD **T
                                                                                                                                                                                                                                                     1**CON4)
  1F(L-1)
                                                                                                                                                                                                                                                                                                                                                                RETURN
                                                                                                                                                                                                                                                                                                        MFLG=5
                                                                                                                                                                                                                                                                                                                                                     して…2
                                                                                                                                                                                                        JK=1
                                                                                                                                                                                                                                                                          JK=1
                                                                                                                                                                                                                                                                                                                                リドニコ
                                                          レスドル
                                                                                                                            一下と
                                                                                                                                                                                                                                                                                                                                                                            END
                                                                                                                                                             2
                                                                                                                                                                                                                                                               [=]
                                                                                                                                                                                                                                                                                            LL.
                                                                                                                                                                                                                  09
                                                                                                                                                                                                                                                                                                                     |
                                                                                                                 // DUP
                                                                                                                                                                                                                                                                                                                                                                                                   *STORE
  .
○ 20
80
                                                                                                                                                                                                                                                                                                                                                     100
                                                                                                                                                                                                                                                                                              96
                                                                                        8
5
                                                                              82
                                                                                                                                                                                                                              92
                                                                                                                                                                                                                                                                                                                                                                                                             *DUMP
                                                                                                                                                 90
                                                                                                                                                           9 1
```

```
MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                MAIN
                                                                                                                                                                                                                                                                                                                                                                                          MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         NIVN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           NIVW
                                                                                      NIVE
                                                                                                                                                               MAIN
                                                                                                                                                                                                                MAIN
                                                                                                                                                                                                                                        MAIN
                                                                                                                                                                                                                                                                  MAIN
                                                                                                                                                                                                                                                                                           MAIN
                                                                                                                                                                                                                                                                                                                   MAIN
                                                                                                                                                                                                                                                                                                                                           MAIN
                                                                                                                                                                                                                                                                                                                                                                  MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                    MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                           MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  COMMON WU2T(10), BD2T(10), W2T(10), REAT(10), UH(10), VU1H(10), AD1H(10)MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ZIVX
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         MAIN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  NIKE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                310),STRB(10),STRT(10),COE(2,2,10),CLEAR(2,10),ARS(2,10),TCRS(2,10)MAIN
                                                         MAIN
                                                                                                             MAIN
                                                                                                                                     MAIN
                                                                                                                                                                                        NIAN
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ADJUSTMENT . K.J = 1, 11)
                                                                                                                                                                                     3SUMHS(2), PREQS, PREQT, IFLAG, CASE1, CASE2, JFLAG, KFLAG, MFLAG, LFLAG, L,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                3CS(10), UC(10), RMF(10), AC1(10), AC2(10), AC1H(10), AC2H(10), AC11(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      4AC2T(10),T1H(10),T1T(10),T2H(10),P1H(10),P1T(10),P2H(10),T2T(10),
                                                                                                                                                              ETTTM,UMA(2),UCO,UCOM,RET(2),RES(2),PRST(2),PRTT(2),UMS,SUMH1(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ZSTRL(2),TUM1,TPT1,TPRST,TSP,M,RHO(2),NFLAG,WF(10),HAVE(10),SJRC(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    2WU2H(10), BD2H(10), WZH(10), REAH(10), T1(10), T2(10), P1(10), P2(10);
                                                                                                                                                                                                                                                                                                                                                                                                                    4PTO(10), ANI(10), HI(10), ANZ(10), HZ(10), UT(10), VUIT(10), ADIT(10),
                                                                                                                                                                                                                                                                  COMMON X(2,10),Y(2,10),REA(2,10),Z(2,10),AD1(2,10),PRSOL,PRTOL,
                                                                                                                                                                                                                                                                                                                                                                                          SKM(16),TT1(10),TT2(10),PRT(10),PRS(10),PRN(10),PT1(10),PT2(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5 FORMAT (5X,4HITER,10X,2HUM,10X,3HPTI,10X,5HPREQS,10X,2HSP,10X,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            *VIH(10);WU1H(10);BDIH(10);W1H(10);VU2H(10);AD2H(10);V2H(10);
                                                                                                                                                                                                                                                                                                                                                                    2W2(10), WU2(10), BD1(10), AD2(10), BD2(10), ETS(10), ETT(10), E(10),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          4.SECON(2,10), ARCON(2,3), SOLID(2,10); DELTA(2), OSF(2), OSEXP(2)
                                                                                                                                                                                                                                                                                                                                           1V1(10)*VU1(10)*VX1(10)*W1(10)*WU1(10)*V2(10)*VU2(10)*VX2(10)
                                                                                                                                    ICOEM(2) .N(2) .DHO(2) .SP(2) .PRSTM(2) .PRTTM(2) .ETST.ETTT.ETSTM.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         COMMON VX2H(10), RMA(10), TT2T(10), TT2H(10), PT2T(10), PT2H(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                             5V1T(10); WU1T(10); BD1T(10); W1T(10); VU2T(10); AD2T(10); V2+(10)
                                                                                                               COMMON IM, ID, IY, R, GAM, CP, VIS, SHP(2), W, TTI(2), PTI(2), UMI(2),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                5P2T(10), COT(10), VEP(10), DVU(10), VX1T(10), VX2T(10), VX1H(10)
                                                                                                                                                                                                                                                                                                                    COMMON UM(10), PAS(10), DHS(10), BMACH, INPAR, TMANI, PMANI,
                                                                                                                                                                                                                                          ETSMM, ETTMM, PTME(2), AREAF, TECE, PECE, RFACT, IPAGE, EMACH
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    1PJ1T(10),PT1H(10),TITL1(20),TITL2(20),TITL3(20)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ( NO SOLUTION FOR CONSTANT TIP RADIUS
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                FORMAT (7X,12,F15,1,F11,1,F14,2,F15,1,F15,1)
                *IOCS)CARD,TYPEWRITER,KEYBOARD,1132 PRINTER,DISK*
                                                                                                                                                                                                                                                                                              ETSOL, ETTOL, UCSOL, UCTOL, UCOT, UCOTM, AREAI
                                                              SUBROUTINES
                                                                                                                                                                                                                         4-PROOS . PROOT . PRSMM . PRIMM .
                                                                 N
N
                                                                 CONTROL
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         GO TO (12,18), INPAR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    (NITOA)
                                                                  MAIN PROGRAM FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                CALL INPT3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALL INPT2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           MFLG=MFLAG
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            16HSTRESS/)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    CALL INPII
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               GO TO 18
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           GO TO 19
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          5,RT(10)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      JOVAL=1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              FORMAT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             MIIM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         10
// FOR
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            52
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       \infty
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       0
```

006.007

02.9

026

040

```
0.79
                                                                                                                                                                                            690
                                                                                                                                                                                                                                                                            0.8.0
                                                                                                                                                                                                                                                                                           082
                                                                                                                                         062
                                                                                                                                                                      99.0
                                                                                                                                                                             190
                                                                                                                                                                                    0.68
                                                                                                                                                                                                                 072
                                                                                                                                                                                                                                                              078
            045
                                          640
                                                               052
                                                                      053
                                                                                      055
                                                                                                                   059
                                                                                                                           090
                                                                                                                                                0.63
                                                                                                                                                        0.64
                                                                                                                                                               065
                                                                                                                                                                                                                                                                                    180
                    940
                                    048
                            047
                                                                                                    057
                                                                                                                                  061
                                                                                                                                                                                                                         MAIN
                                                                                                                                                                                                                                MAIN
                                                                                                                                                                                                                                        MAIN
                                                                                                                                                                                                                 MAIN
                                                                                                                                                                             MAIN
                                                                                                                                                                                                                                               MAIN
                                                                                                                                                                                                                                                              MAIN
                                                                                                                                                                                                                                                                      MAIN
                    MAIN
                                                        MAIN
                                                                MAIN
                                                                                      MAIN
                                                                                                                                                MAIN
                                                                                                                                                                                                          MAIN
                                                                                                                                                                                                                                                       MAIN
                                                                                                                                                                                                                                                                             MAIN
                                                                                                                                                                                                                                                                                    MAIN
                                                                                                                                                                                                                                                                                           MAIN
                                                                                                                                                                                                                                                                                                   MAIN
                                                                                                                                                                                                                                                                                                          MAIN
                                                                                                                                                                                                                                                                                                                  ZIVX
                                    MAIN
                                           MAIN
                                                 MAIN
                                                                       MAIN
                                                                               MAIN
                                                                                              MAIN
                                                                                                    MAIN
                                                                                                            MAIN
                                                                                                                   MAIN
                                                                                                                           MAIN
                                                                                                                                  MAIN
                                                                                                                                         MAIN
                                                                                                                                                        MAIN
                                                                                                                                                               MAIN
                                                                                                                                                                      MAIN
                                                                                                                                                                                                  MAIN
                            MAIN
                                                                                                                                                                                            MAIN
                                                               ITER,UM1(1),PTI(1),PREQS,SP(1),STRT(K)
                                                                                                                                                                                                    GO TO (65,65,55,55,100); MFLG
                                                                                                                                                         46,48,48
                                                                                                                                                                                                                          PRATO (MFLG*JK*K)
                                                                                                                                                                                                                                                                                             F (M-4) 105,105,150
                                                                                                                                                                                                                                                                                                     F (L-1) 110,110,106
                                                                                                                                           CALC2(KJ,VU1IN)
                                                          ,8),KFLAG
                                                                                                                                                                                                                   CALL OVALL (JOVAL)
                                                                                                                                                                                                                                  TO (16,100),JK
                                                                                                                                                                               GO TO (50,251,K)
                                                                                                                                                                                                           GO TO (65,60) +L
                                                                                                                                                 KCONT = KCONT+1
                                                                                                                                                                                                                                         IF (IFLAG-2)
                                                                                                                                                         IF(KCONT-10)
                                                                                                                                                                WRITE (3,11)
                                                                                              SUMHS(L)=0。
                                                                                                      SUMHT (L) =0.
                                                                                                                                                                                                                                                                                                                           CALL STRES
                                                                        MFLG=MFLAG
                                                                                                                                    CALCI
                                                                                                                                                                                                                                                 CALC4
                                                                                                                                                                                                                                                         CALCS
                                                                                                                                                                                                                                                                       CALC6
                                                                                                                                                                                                                                                                              CALCT
                                                                                                             PRTT(L)=1
                                                                                                                    PRST(L)=1
                                                                                                                                                                                                                                                                GO TO 40
                                                                                KCON1=0
                                                                                                                                                                                                                                                                                                                    NFLAG=1
                     NFLAG=1
             ITER=0
                                                                                       UMS=0.
                             K=N(1)
                                                  WRITE
                                                                                                                                                                                                                          CALL
                                                                                                                                                                                                                                                                       CALL
                                                                                                                                                                                      CALL
                                                                                                                                                                                                                                                 CALL
                                                                                                                                    CALL
                                                                                                                                           CALL
                                                                                                                                                                                            CALL
                                                                                                                                                                                                                                                                                      CALL
                                                                                                                                                                                                                                                                               CALL
M=M
                                                                                                                                                                                                                                                        CALL
                                                                                                                                                                                                                                                                                                             0 II W
        11
                                                                                                                                                                                                                                         100
                                                                               16
                                                                                                                                                                               64
                                                                                                                                                                                     50
                                                                                                                                                                                                                   09
                                                                                                                                                                                                                          ω
9
                                                                                                                                                                                                                                                20
                                                                                                                                                                                                                                                                       30
                                                                                                                                                                                                                                                                                      04
                                                                                                                                                                                                                                                                                                     105
                                                                                                                                                                                                                                                                                                            106
                                                                                                                                                                                                                                                                                                                            110
                                                           4 1~
                                                                                       S
                                                                                                                                                                                                             S
                                                                         ထ
```

		. 0			-		•		တ	17	7				Д 5	14		14		يب ري			بر ن	13		ري دي		12			1					ر س د سه		1	_ }-		•
i i	<u>ာ</u> ရ	ر د د	_ G) <u>C</u>	- 0	-					\sim	—	Ç	_	50 0		ଜ	0.5	Ó	7 MF			- 10	5 1 F	GC	OP1	(O)	5 C	⊶ :	·	⊃. - 7 (ت	Ti -		TO (ຫ . ດ (n (4 C C C C C C C C C C C C C C C C C C C	• • C) 4
Č	? · .	ALL	: > ~					V	_			_	_	<u></u>		\searrow	- 7	7		Ä		ER	EQ	-	_			1 (<u>_</u>	_ 5	П О -	7	A Z	יוני מו	Ö :	<u>-</u>		- 1			12
		0 1	ı J⊢) = S) = P) = T			1	FLA	007	(4)	-1	-4	-	116		TS.	14	 	יה תק	H	= TP	-4)) = T	14) = T	2)	7 F 70 I	- 1 -1 i	<u></u>) 	11	a . :	٠.	W. P		~ <i>)</i> ~		
				2		2			9	هنسو	N				PT			70) + 2 - 1			+	RST	136		PTI		وسيو	125	15)	<i>↓</i> + -			λυ + 		50 • 1	S) (S)		→ 	- (C	7
		JOVAL		* *	_	٥			0 + 19			0 - 1 6	1 11 2								μ ω			5,14					ن سر سر							20•	155. 1		- - -	· -) <u> </u>
				141					0,2	-		0 • 1									7			0.1					, 						1	117			ر • ا	, }-	اسباد جاد سازر
				少 ※)					8		70	4 2 2											50					S)				A.			150			1		
				龙区(人			1000 1000 1000 1000			0			- 3.8 - 2.7 - 33.4 - 3.7								41									41						υ ω			 	→	
) 次 大)																															6					•
				FACI	•																															ZFC				2	<u>₹</u>
				/30												*8																				AG				C	>
				•												i W																					14 8 4544				
							. u																								1.										
													, j																												
						÷																																			
									. j 1935) 현													+ 13																		
			٠.																																		10. s				
																									3					•									- 345		
																														•											
	KA X		MAI	3 3 3 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A 1 A	5 3 2 4 F	:	\ } 	A		X A	X A	MAL	X A L	: 3 : > :	3		> I	-4 P	- +)-		-4 1-		4 1	4 1-	4 }	4 1-		+ +		1-4		SIAI	p		-		•	3		NA NA NA
1		ZZ					سي د	Z	د		2	i		 		2 Z	_ د	٠.	بر دست	بر د ـــ	سودست	شۇ ئىس	ہے د		. μ	4	نــو ه		نسو ه	0	0	0	0	0		0	0	Ó	0	0	
	0 7	0 @ 2 \/2 - \(/2 \)	27	900	n T	3 N 5 U) N	\\ 	, O	· <u> </u>	o o	· -	10	· 1-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	- r	2 1) i	;	ے (ح ا	ن 0	ر - م	7 0	ر بر	ų ţ	ξ <u>υ</u>	؉ د	ب بور	. O	ξ¢	38	7	96	ÿ	4	Ü	32	سَم	ŏ,	9	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
¥ .		74,																															 • :	.:8 .:A							
		•																			ngi Ngiri																1				

// DUP *STORE UA MAIN

A CD MAIN

```
0
    STAGES* SECOND SPOOL * * * * * * * * * *
                                                                      0.2
                                                                      300.
                                                                                                                                          ੵ
                                                                                                                              7.
                                                                      1660.
                                                                                                     65
                                                                                                                                                            5
                                                                                                                                                                  60
                                                                                                                                          C
                                                    TO DEMONSTRATE COMPUTER PROSRAM........
                             766.3700001.391000003.504000000.0001340
                                                                                                                                                            ري
•
ام
                                                                                                                                          0.
                                                                                                            9
                                                                                                                              -J
                                                                                                                                                  •
                                              SPOOL-75JAGES, FIRST SPOOL-53
                                                                                                                                                                               .
Ф
                                                                                                     69
                                                                                                                                                            1:5
                                                                                                                                          ៊ី
                                                                                                                                                      ٠
س
                                                                                                                              7.
                                                                                                                                    .d
•
                                                                                                                                                  ٠
                                                                                                                                                                                                                                * • 0
                                                                                                                                                                                                                                      1.5
                                                                                                                                                                                                                                                              60•
                                                                                                                                           C
                                                                                                                                                                                                                                             ...
                 *LOCALPRATOSOVALL
                                                                                                                                                                               50000.
15000.
                                                                                   50000°
                                                                        1400.
                                                                                                                                                                                                                                                              600
                                                                                                                                                                                                                                                        ं द्<u>र</u>ी
                                                                                                                                                                   φ
•
                                                                                                                                                                                                                                 5. 4
// XEQ MAIN
                                                                                                                                                             un.
                                          EXAMPLE
                                    66-6666
                       030668
                                                                                    40000
                                                                                                                                                                                     0000
                                                                                                                                                                                .300
                                                                  10.0
                                                OSI,
                                                                         10.
                                                                               C
                                                                                                                                                             មា
                                                                                                                                                                   00
                                                                                                                                                                                                                                .4.
                                                                                                                                                                                                                                             s,
•
                                                                                                                                                                                                                                      Ċ
                                                                                                                                           0.
                                                                                                0
```

EXAMPLE CASE

COMPUTER PRINTED OUTPUT

004*1	060.0 06.0	00*1 010*0 00**0 00**0	000*1 000*1 005*0	0°150 63°00
004 • T	060.0 06.0	00°t 010°0 009°0 009°0	000°T 000°T 009°0	00*59 001*0 9
005°T	060.0 06.0	00°t 000°0 000°0 000°0	000*T 000*T 009*0	00.74 080.0 8
004.1	060.0 06.0	00 • 1 010 • 0 00 0 00 0 00 0	000*1 000*1 000	00*69 090*0 7
009 • 1	060*0 06*0	00*1 010*0 007*0 007*0	000*T 000*T 008*0	3 00.00 71.00
005-1	060*0 06*0	00*0 0*00 0000 000	000*1 000*1 006*0	2 0.020 73.00
005.1	C40*0 0E*0	00*1 010*0 007*0 007*0	1,000 1,000 1,000	00°54 000°0 t
009 1	*15NOO	COEFF. COEFF. IN	RATIO RATIO RATIO	DEG
	RATIO MODULUS	LOSS CLEAR RATIO	LOAD RADIUS VELOCITY	REACTION ANGLE
SOCIDILL	TH/CD SECTION	NOZZLE ROTOR ROTOR ASPECT	STAGE MEAN AXIAL	STAGE STAGE NOZZLE
VIIII 102	MO11233 037A1	155037 80108 50100 5 12100	17177 177317 23729	23723 33723
		PARAMETERS	STAGE IN	
		THIAN	•	006*0 0*00005
		NONE	N.	0°0000\$ TB\Cn=1
		DATA SWITCHES ON		STRESS LIMIT MATERIAL DE
		MO 2342TIM2 AIAG	YEON! GETEMANA	34 (A1031AW TIME) 323412
		7*000 3*000	0.0000E 00 1.000	O*10000E O1 O*00000E 00
	ONENT	OVERSPEED FACTOR OVERSPEED EXP	A DISTRIBUTION DELTA	BLADE CROSS SECTION ARE
			and the second s	
	004.0	7.0000 20000°C	0.00€ 0.0991	57.51 0.0000
	And the second of the second	FI/SEC RPM	A 129	735/81
	COEFFICIENT	SPEED SPEED	TEMPERATURE PRESSURE	новзеромев вуте
	MAN. LOSS	MEAN BLADE ROTATIVE	INLET TOTAL INLET TOTAL	SHAFT FLOW
		ONDILIONS	7047	
		SNOTTIONS	7 3347	
	70-30781.0	705*€	165*1	16.001
	LB/FT-5EC	81U/L8-DEG R	.00	F1/0EG_R
	VISCOSIV	SPECIFIC HEAT	OITAR	CONSTANT
	ABSOLUTE	CONSTANT PRESSURE	SPECIFIC HEAT	CVS
	311.10304	3033300 27333		
		ROPERTIES	4 SA5	
		*****************	RATE COMPUTER PROSRAM	
		2. SECOND SPOOL	75TAGES, FIRST SPOOL 3 STAGE	CHARACTERISTICSTWO SPOOL-
	66=6666	****************		APPLICATIONEXAMPLE CA
	CASE NUMBER			the state of the s
	•	BER I OF 2	SPOOL NUM	
		ALYS15		
		BINE DESIGN		
DEX PAGE	INI	STAGE	<u>L</u>	DATE03-01-68

)

Ο.

)

•

005*1	060*0	0.08.0	00 • 1	oro•o	007.0	007.0	000°T	000*1	005*0	00.69	021.0	L	
005*1	060*0	0.30	00°T	0.010	007.0	007.0	000 • 1	000°t	005*0	00 • 5 9	001.0	9	
005*1	060.0	06.0	00 • 1	010.0	007.0	007.0	000°T	000°I	009 0	00.79	080.0	ģ	
005*1	060*0	0.00	00 • T	010.0	- 005 • 0	007.0	000 • 1	7.000	007.0	00 • 69	090•0	7	
004.1	060*0	05.0	00 • 1	010.0	007.0	007.0	000-1	000*1	003.0				
005*1	060 0	06.0	7°00							71.00	070.0	٤	
				0.00.0	007.0	007.0	1.000	000°t	006•0	73.00	0.020	2	
0.05 °.1	050.0	0.50	00 • 1	010.0	007.0	007.0	1.000	000.1	7.000	00.27	00000	τ	
	•12NO>			N I	COEFF	COEFF	OITAR	OITAR	OITAR	930			
	MODULUS	OITAR	OITAR	CLEAR	5507	5507	VELOCITY	RADIUS	LOAD	ANGLE	REACTION		
SOLIDITY	SECTION	TH/CD	TOB92A	80108	яотоя	BUSSLE	TATXA	NABM	3DAT2	BIZZON	STAGE	STAGE	
					RETERS	ARAG TUG	STAGE IN						
.*				3	NON			0		006.0	0.	00005	
								-		-03/87		15d	
				NO SE	STIME ATA	0	ILR INDEX	FAMARA9.	ENSILY	INTERIAL D	4 TIMI-	STRESS	
			3•000		000	•1	000*1	00 30	00000	00 300000	0 to 300	00110	
		ONENT	яхэ оээчгя	OVE.	ROTDAR 03	OVERSPE	ATJEO	NOTION	IRTZIQ A3	RA MOITOB	ADE CROSS S	79	
			April 1										
		00000										. 2	
		005*0	0.00		0.0041		0.00€		0.0991	54.6		*0000	
		21.1702	Md		D32/19		AISG		9 530) 32 C	•		. 14
		COEFFIC	033		SPEED		PRESSURE		TEMPERAT	3TA		HORSEPO	
	350	A .NAM	ATIVE	108	AN BLADE	ME.	INLET TOTAL	JATO	INCET TO	MOT.	i .	TAAHS	
					C.N	CONDILIO	2047						
							3343						
	200		1										
	1340E-04	• 0		709	;• €	٠,	te	5 E * l		1699	997		1
	751-SEC	ย า			81/018					ย้อั			
1	X1150DS	IΛ	The second	TABH DI			01	I TAR		INAT			
	SOLUTE	8.₩	- 7		TNATZNOD			SPECIFIC			19		
			· •							•	,		
					53	PROPERTI	SAD						
			- A • •				MA930	DRY RETURN	TRATE COM	LO DEMONS		DROFCLL	
					**************************************	2E2 2ECO	VAIS 61004	FIKEL SH	-121Y0F2	JOOAS OMI-	EKIPLICP	LIDANAND	
	66-6666	. *	••	* * * * * * * *					******35Y	S BUNNAX 3-	NOI	VANTICE	
								1 1 1 1 1	. j				
ER	CASE NUMB												
					Z 40	WBER T	SPOOL N	. (
			:			- 525/11			1.0		t		
			:							•		1	
						SISTIANA	<i>t</i> .						
					RIGN	JEBINE DE							
BYCE T						30AT2 T					99-10	-£03140	.1
											0,		
							· ·						
	•												
							1						
			· *							•		1 × 1	

DATE03-01-68

STAGE VELOCITIES

S PAGE 2

FREE VORTEX

			•										
	STAGE	U FT/SEC	VU1 FT/SEC	VX1	V1	WU1	W1	VU2	VX2	V2	WU2	w2	REACTION
	1			FT/SEC	FT/SEC	FT/SEC	FT/SEC	FT/SEC	FT/SEC	FT/SEC	FT/SEC	FT/SEC	
	. •	1278.0	5096.1	1251.8	5247.6	3818 • 1	4018.1	-2050.6	1251.8	2402.5	-3328.6	3556.2	-0.191
		1400.0	4671.9	1251.8	4836.7	3271.9	3503.2	-1871.9	1251.8	2252.0	-3271.9	3503.2	0.000
		1521.9	4312.9	1251.8	4490.9	2790.9	3058.8	-1721.9	1251.8	2128.9	-3243.9	3477.1	0.148
	2	1255.2	4793.2	1319.7	4971.6	3537.9	3776.1	-1754.1	1319.7	2195.1	-3009.3	3286.0	-0.210
		1400.0	4316.7	1319.7	4514.0	2916.7	3201.4	-1572.7	1319.7	2053.1	-2972.7	3252.5	0.020
		1544.7	3926.4	1319.7	4142.3	2381.7	2722.9	~1425.4	1319.7	1942.6	-2970.1	3250.1	0.190
									232761	174210	-271011	323041	0.170
	3	1229.0	4491.4	1364.1	4694.0	3262.3	3536.1	-1450.7	1364.1	1991.3	-2679.7	3006.9	-0.237
		1400.0	3961.5	1364.1	4189.8	2561.5	2902.1	-1273.5	1364.1	1866.2	-2673.5	3001.4	0.040
		1570.9	3543.5	1364.1	3797.0	1972.6	2398.3	-1135.0	1364.1	1774.5	-2705.9	3030.3	0.233
		1100.1											
	4 .	1199.1	4189.2	1384.3	4412.1	2990 • 1	3295.0	-1137.5	1384.3	1791.7	-2336.7	2716.0	-0.272
		1,400.0	3606.3	1384.3	3862.9	2206.3	2604.7	-974.3	1384.3	1692.9	-2374.3	2748.4	0.060
		1600.8	3165.8	1384.3	3455.3	1565.0	2089+4	-852.1	1384.3	1625.6	-2452.9	2816.6	0.277
	5.	1165.4	3884.7	1380.0	4122.6	2719.3	3049.5	- 811 0	1000 0				
		1400.0	3251.1	1380.0	3531.9	1851.1	2308.9	-811.0	1380.0	1600.7	-1976.5	2410.6	-0.318
100		1634.5	2795.2	1380.0	3117.4	1160.7	1803.2	-675.1 -578.2	1380.0	1536.3	-2075.1	2492 • 1	0.080
		••••		130000	214177	110001	100342	-21002	1380.0	1496.3	-2212.6	2607.9	0.321
	6	1127.4	3575.7	1350.4	3822.3	2448 • 2	2796.0	-466.8	1350.4	1428.8	-1594.3	2089.4	-C.378
		1400.0	2895.9	1350.4	3195.3	1495.9	2015.3	-375.9	1350.4	1401.8	-1775.9	2231.1	0.100
		1672.5	2433.3	1350.4	2782.9	760.8	1550.0	-314.7	1350.4	1386.6		2402.6	0.366
										,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		240210	V + 3 C D
	7	1109.6	3593.4	1461.3	3879.2	2483.7	2881.7	-509.6	1461.3	1547.6	-1619.3	2181.2	-0.389
		1400.0	2867.9	1461.3	3218.8	1467.9	2071.3	-403.9	1461.3	1516.1	-1803.9	2321.6	0.120
		1690.3	2386.2	1461.3	2798.1	695.9	1618.5	-334.6	1461.3	1499.1		2497.1	0.393

FREE VORTEX

	STAGE	ABSOLUTE	RELATIVE
	7	NOZZLE EXIT	ROTOR EXIT
	1	0.730	0.492
		0.668	
			0.484
* 1		0.616	0.480
	2	0 717	
	2	0.713	0.468
		Q+642	0.463
		0 • 5 8 5	0.462
	3	0.693	0.441
		0.613	0.439
		0.552	0.443
	11		
	4	0.669	0.408
		0.580	0.413
		0.515	0.423
		00222	
	100		
	. 5	0.640	0.371
		0.542	0.383
		0.476	0.401
•			••••
	6	0.606	0.328
	_	0.501	0.350
		0.434	0.377
		0.454	. 0.511

	7	0.630	0.351
		0.516	
			0.373
		0.446	0.401

DATE03-01-68			STAGE GEOM	ETRY				PAGE 4
			FREE VORT	EV				
			FREE VORT	£ A				
	EAN BLADE DIUS HEIGHT 1	BLADE HEIGHT 2	ANNULUS AREA 1	ANNULUS AREA 2	ALPHA1	BETA1	ALPHA2	BETA2
11	IN IN	IN	50-IN	SQ-IN	DEG	DEG	DEG	DEG
1 8 • 0	1.335	1.397	67.302	70 • 448	76.19	71.84	-58.59	-69.38
					75.00	69.06	-56.22	-69.06
					73.81	65.84	-53.98	-68.89
2 8.0	1.594	1+658	80.378	83.584	74.60			
-	1.57,4	10000	004510	030304	73.00	69.54 65.65	-53.04 -49.99	-66.31
and the second second					71.42	61.00	-47.20	-66.06 -66.04
						01.00	-47420	-00104
3 8.0	1.892	1.958	95.390	98.719	73.10	67.30	-46.76	-63.02
					71.00	61.96	-43.03	-62.96
	•				68.94	55.33	-39.76	-63.24
4 8.0	2.232	2.301	112.504	116 070	7. 7.			
7	214 21232	2.301	112+504	115.978	71.71 69.00	65.15	-39.41	-59.35
					66.38	57.89 48.50	~35.13	-59.75
				•	00 • 20	48.50	-31.61	-60.56
5 8 • 0	214 2.616	2.688	131.874	135 477	70.44	63.09	-30.44	-55.07
					67.00	53.29	-26.07	-56.37
	• •				63.72	40.06	-22.73	-58.05
6 8.0	214 3.049	3.122	153.717	157.382	(0.01			
0 3.0	7214 5.049	34122	1224111	1214305	69.31 65.00	61.11 47.92	~19.07 ~15.55	-49.73
					60.97	29.39	-13.11	-52.75
		and the second				£ 7 € 3 7	-13-11	-55.80
7 8.0	214 3.238	3.326	163.234	167.660	67.87	59.52	-19.22	-47.93
and the second second					63.00	45+13	-15.45	-50.99
					58+51	25.46	-12.89	-54.18

والمناز والمناز والمناز

ತ					100					
7	DATE03-01-68		PRESSURES					TEMPERAT	URES	PAGE 5
. (14					
<i>(</i> .				•	FREE VOR	TEX				
		1								
	STAGE	PT1	P1 PT2	P2	PRS	PRT	TT1	Ti	TT2	T 2 .
• (PSIA	PSIA PSIA	PSIA			DEG R	DEG R	DEG R	DEG &
	1 · · · · · · · · · · · · · · · · · · ·	289.0	202.9 219.1	203.0			1660.0	1503.0	1555.5	1522.6
		289.0	214.5 219.1	204.9	1.443	1.350	1660.0	1526+6	1555.5	1526.6
		289.0	223.9 219.1	206.4		A Section 1	1660.0	1545.0	1555.5	1529.7
(2	211.7	151.0 163.6	153.0			1555.5	1414.6	1461.5	1434.1
		21147	160.6 163.6	154.3	1.420	1.338	1555.5	1439.4	1461.5	1437.5
		211.7	168.0 163.6	155.2			1555.5	1457.7	1461.5	1440.0
· C .										
	3	159.4	115.8 125.7	118.5			1461.5	1335.9	1070 0	1355.4
1	•	159.4	123.9 125.7	119.4	1.370	1.301	 1461.5	1361.5	1378.0 1378.0	1356.1
		159.4	129.7 125.7	120.0			1461.5	1379.4	1378.0	1360.0
								251764	13.000	
. (.,										
	4	123.3	91.4 99.3	94.5			1378.0	1267.0	1304.9	1286.6
		123.3 123.3	98.3 99.3	95.0	1.323	1.265	1378.0	1292.9	1304.9	1288.5
. `		123.3	102.9 99.3	95.3			1378.0	1309.9	1304.9	1289.6
								· · · · · · · · · · · · ·		
(· ·	5	97.9	74 • 4 80 • 9	77.5			1304.9	1208.0	1242.2	1227.6
		97.9	80 • 2 80 • 9	77.8	1.277	1.228	1304.9	1233.8	1242.2	1228.5
		97.9	83.9 80.9	77.9			1304.9	1249.5	1242.2	1229.5
1 1	6	80.1	62.5 67.9	65+5			 1242.2	1159.0	1190.5	1176.4
. (80.1	67.5 67.9	65.6	1.231	1.190	1242.2	1184.0	1190.0	1178.6
		80.1	70.4 67.9	65.7		1	 1242.2	1198.1	1190.0	1179.0
,						e di				
(·										
		67•2 67•2	51.5 56.6	54.2	1 2/0	1 100	1190.0	1104.2	1137.8	1124.1
(- 1 - 4 N	67.2	56•1 56•6 58•7 56•6	54•3 54•4	1.249	1.199	1190.0	1131.0	1137.8	1124.7
No. 1	The Control of the Co	0142	20.0	2404			1190.0	1145.4	1137.6	1125.0

1113.	1213	1199	Teaq	,00/n	00/0	AMU	н тэо	
	PERFORMANCE	BLADE	OVERALL					
		• .						
		666.0	188.0	S27.0	185.9	L27°0	L	
		166.0	978.0	867.0	185*6	754.0	9	
		856.0	758.0	S27.0	51612	955.0	\$	
		75E.0	828.0	007.0	1.995	50E 0	4	
		006.0	008•0	719.0	1.292	792.0	ε	
		975.0	191.0	£79°0	356.3	765.0	2	
		0.261	911.0	149*0	6.596	0.213		
		00/0	113	813	H J30 8J/U18	LAMDA	BDATZ	

1.7431 DEG-R

967*9

1189

961.0

1

562.6

AISG

BHILD

1913

777°G

INCET MANIFOLD CONDITIONS

OVERALL TURBINE PERFORMANCE INCLUDING MANIFOLD

0.830

1113 048.0

2.224

\$67.8

815.5

1289

0.133

Alsq

9 3949

7.040

BES

1.039

138

998 *0

STAGE PERFORMANCE

DATE03-01-68

NI-05

0.132

1829.6 810/L8 9.6281

00/0

9EI*0

100/0

0.0041

DAS/T4

ABBA

DATE03-01-68

ROTOR BLADE ROOT STRESS

STAGE		AVERAGE DE HEIGHT IN	STAGE C LOAD PERCENT	ENTRIPETAL STRESS PSI	BENDING STRESS PSI	TOTAL STRESS PSI
1	8.0214	1.366	20.0	37362.2	1877.8	39240.0
2	8.0214	1.626	18.0	44471.6	1419.8	45891.4
3	8,00214	1.925	16.0	52648.5	1066.0	53714.6
4 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	8.0214	2.266	14+0	61971.4	792+4	62763.9
5	8.0214	2.652	12.0	72513.9	580.5	73094.4
6	8.0214	3.086	10.0	84379.9	415.7	84795.6
7	8+0214	3.282	10.0	89749.1	390.8	90139.9

8	PAGE

3 STAGE GASTGN ANALYSIS

DATE03-01-68

CASE NUMBER 2 OF 2 2000 24-00											
CASE NUMBER RESIDENCE———EXAMPLE CASE NUMBER COMPUTER PRODUCHS FOR STATES SECOND SPOOL STORES, FIRST SPOOL—3 STORES, SECOND SPOOL SPOOL STORES, FIRST SPOOL—3 STORES, SECOND SPOOL SPOOL SPOOL STORES, FIRST SPOOL—3 STORES, SECOND SPOOL S	1.500	060*0	06.0 00	7 070*0	004.0	00017	0000		11111		
CASE NUMBER CONSTINCTION———EXAMPLE CASE. CONSTINCT FLOW THAPE CROSS SECTION ARE DISTRIBUTION CASE STACES CONSTINCT FLOW	005.1	060*0				,					•
CASE NUMBER CHARACTERISTICSTO SPOOL-75TAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CHARACTERISTICSTO SEQUENTER PROGRAM. CASE CONSTANT SHAFT FLOW CONSTANT CASE CONDITIONS CONSTANT CASE CONDITIONS CASE SECTION AREA DISRIBUTION CASE CONDITIONS CASE SECTION AREA DISRIBUTION CASE CONDITIONS CASE CONDITI	305 * 1	060*0									2
CARRACTERISTICSTWO SPOOL-7STAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CARRACTERISTICSTWO SPOOL-7STAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CONSTANT CONSTA		*1SNOD								000 • 0	τ.
CARRACTERISTICSTWO SPOOL-75IAGES, FIRST SPOOL3 STACES, SECOND SPOOL. GAS DELECTIVE		- WODULUS	OITAR OITA								
CHARKCIERISTICSTWO SPOOL-75TAGES, FIRST SPOOL3 STACES, SECOND SPOOL. CHARKCIERISTICSTWO SPOOL-75TAGES, FIRST SPOOL3 STACES, SECOND SPOOL. CONSTANT SATIONAL SPOOL-15TAGES, FIRST SPOOL3 STACES, SECOND SPOOL. CASE CONSTANT SATIONAL SPOOL-15TAGES, FIRST SPOOL3 STACES, SECOND SPOOL. CASE CONSTANT SATIONAL SATIONAL SPOOL SPOOL SPOOL SATIONAL SPEED COEFFICIENT STACES SECTION AREA DISTRIBUTION DELTA SASOR 1050.0 1500.0 15	SOLIDITY	SECTION									
CHARACTERISTICSTO DEMONSTRATE COMPUTER PROGRAM. CHARACTERISTICSTO DEMONSTRATE COMPUTER PROGRAM. COMSTANT FLOW THE TOTAL TOT					2 1220		IN S ATT	35AT2	A IZZON	ADAT2 30	ATZ
APPLICATION————EXAMPLE CASE. CHARACTERISTICS——TWO SPOOL -751AGES, FIRST SPOOL——3 STAGES, SECOND SPOOL CONSTANT FIVEG R SHAFT CONSTANT CASE CONDITIONS CASE CASE CONDITIONS CONDITIONS CASE CONDITIONS CASE CONDITIONS CONDITIONS CONDITIONS CAS CAS CONDITIONS CONDITIONS CONDITIONS CAS CONDITIONS CONDITIONS CONDITIONS CONDITIONS CAS CAS CONDITIONS CONDITIONS CO					ZABTEMARAG TI	STAGE INPL					
APPLICATION————EXAMPLE CASE. CHARACTERISTICS——TWO SPOOL -751AGES, FIRST SPOOL——3 STAGES, SECOND SPOOL CONSTANT FIVEG R SHAFT CONSTANT CASE CONDITIONS CASE CASE CONDITIONS CONDITIONS CASE CONDITIONS CASE CONDITIONS CONDITIONS CONDITIONS CAS CAS CONDITIONS CONDITIONS CONDITIONS CAS CONDITIONS CONDITIONS CONDITIONS CONDITIONS CAS CAS CONDITIONS CONDITIONS CO			A second control of the control of t								
CASE NUMBER CHARACTER/STICS					NONE		,		0010		
APPLICATION———EXAMPLE CASE. CHARACTERISTICS——TO DEMONSTRATE COMPUTER PROGRAM. CAS PROPERTIES CONSTANT FILDEG R CONSTANT FIL				· .			,				9
CHARACTERISTICSTWO SPOOL-TSTAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CHARACTERISTICSTWO DEMONSTRATE COMPUTER PROGRAM. CONSTANT SAAFT CONSTANT				IES ON	DATA SWITCH	TER INDEX	PAKAME				
APPLICATION————EXAMPLE CASE. CHARACTERISTICS——TWO SPOOL—751AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CHARACTERISTICS——TWO SPOOL—751AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CONSTANT CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CASE CONSTANT CASE CASE CONSTANT CONSTANT CONSTANT CASE CONSTANT CONSTA						··· , - 			TATOSTAN	T141 1 223	912
APPLICATION————EXAMPLE CASE. CHARACTERISTICS——TWO SPOOL—751AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CHARACTERISTICS——TWO SPOOL—751AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CONSTANT CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CONSTANT CASE CASE CONSTANT CASE CASE CONSTANT CONSTANT CONSTANT CASE CONSTANT CONSTA										•	
APPLICATION————EXAMPLE CASE. CHARACTERISTICS——TWO SPOOL—757AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL. CHARACTERISTICS——TWO SPOOL—757AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL. CHARACTERISTICS——TWO SPOOL—757AGES, FIRST SPOOL—3 STAGES, SECOND SPOOL. CHARACTERISTICS——TWO SPOOL—757AGES, FIRST SPOOR—10 SPOOL—10			000∙€		000 • ₹	000°T	00 BO	0000*0 0	0 300000 · 0	* TOOOOF OF	0
APPLICATION————EXAMPLE CASE CHARACTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CHARACTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL CONSTANT FIVDEG R SHAFT FLOW HORSEPOWER RATE TEMPERATURE SHAPE CASE COOST CASE COOST COOS			INTROJET OT	1001140							•
APPLICATIONEXAMPLE CASE. CHARACTERISTICSTWO SPOOL-7STAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CHARACTERISTICSTWO SPOOL-7STAGES, FIRST SPOOL3 STAGES, SECOND SPOOL. CONSTANT FIVES CONSTANT CONSTANT FLOW INLET TOTAL CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONTIVE CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT BAUVLB-DEG R LBNFT-SEC LBNFT-SEC LBNFT-SEC LBNFT-SEC LBNFT-SEC LBNFT-SEC CONSTANT CASE CONDITIONS CASE CONTIVE CONSTANT CONSTANT CONSTANT BANCE CONSTANT CONSTAN			THE EXPONENT	OVERSE	ADIDAR GREED FACTOR	DELTA	NOITUB	REA DISTRI	SECTION A	BLADE CROSS	
APPLICATION————EXAMPLE CASE CHARACTERISTICS——10 DEMONSTRATE COMPUTER PROGRAM CONSTANT CONSTANT CONSTANT FLOW HORSEPOWER RATE TEMPERATURE PRESSURE SHAFT FLOW 1000001 1000001 TOTAL TOTA											
APPLICATION———EXAMPLE CASE CHARACTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL GAS CHARACTERISTICS——TO DEMONSTRATE COMPUTER PROGRAM GAS GAS GAS GAS GAS GAS GAS G		00	10°T	*00051	0.0007	0406			200		
APPLICATION————EXAMPLE CASE CHARRCTERISTICS———TO DEMONSTRATE COMPUTER PROGRAM CHARRCTERISTICS——TO DEMONSTRATE COMPUTER PROGRAM CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT CASE CONDITIONS CASE CONSTANT CASE									0.000	O T	
APPLICATION————EXAMPLE CASE		ICIENI	COEFF				7310				
APPLICATION————EXAMPLE CASE NUMBER CHARROTERIST SPOOL——3 STAGES, SECOND SPOOL. CHARROTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL. CHARROTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL. CAS SPECIFIC HEAT CONSTANT RESSURE CONSTANT RESSURE CONSTANT RESSURE TABLE SPOOL—134CE—04 TABLE SPOOL—134CE—04 CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS CASE CONDITIONS		5507									
APPLICATION————EXAMPLE CASE CHARRCTERISTICS——TO DEMONSTRATE COMPUTER PROGRAM CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT BTU/LB-DEG R D - 1940E-04 BTU/LB-DEG R D - 1940E-04						17104 13 1114	IATO	THINT	FLOW	TRAH	S
APPLICATION————EXAMPLE CASE CHARRCTERISTICS——TO DEMONSTRATE COMPUTER PROGRAM CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT CONSTANT BTU/LB-DEG R D - 1940E-04 BTU/LB-DEG R D - 1940E-04				* *	SNOILIGNS	CYPE C					
APPLICATION————EXAMPLE CASE NUMBER CHARROTER SPOOL——3 STACES, SECOND SPOOL OBJECTIVE—————TO DEMONSTRATE COMPUTER PROGRAM. GAS PROPERTIES CONSTANT CONSTANT RATIO SPECIFIC HEAT SPECIFIC HEAT CONSTANT BIU/LB-DEG R LB/EB-DEG R LB/EB						7, 77, 7					
APPLICATION————EXAMPLE CASE NUMBER CHARROTER SPOOL——3 STACES, SECOND SPOOL OBJECTIVE—————TO DEMONSTRATE COMPUTER PROGRAM. GAS PROPERTIES CONSTANT CONSTANT RATIO SPECIFIC HEAT SPECIFIC HEAT CONSTANT BIU/LB-DEG R LB/EB-DEG R LB/EB	•										
APPLICATION————EXAMPLE CASE CHARROTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL GAS SPOORTANT CONSTANT GAS SPECIFIC HEAT CONSTANT CONSTANT SPECIFIC HEAT VISCOSITY RESSURE TAINLE SPOOLUTE SPECIFIC HEAT VISCOSITY RESSURE TAINLE SPOOLUTE SPECIFIC HEAT VISCOSITY RESSURE FIVE SPOOLUTE BINLE SPOOLUTE FIVE S						. 16	£ • T		10.001		
APPLICATION————EXAMPLE CASE CHARACTERISTICS——TWO SPOOL—75TAGES, FIRST SPOOL—3 STAGES, SECOND SPOOL OBJECTIVE—————TO DEMONSTRATE COMPUTER PROGRAM OBJECTIVE—————TO DEMONSTRATE COMPUTER PROGRAM OBJECTIVE—————TO DEMONSTRATE COMPUTER PROGRAM OBJECTIVE—————TO DEMONSTRATE CASE OBJECTIVE————TO DEMONSTRATE CASE OBJECTIVE—————TO DEMONSTRATE CASE OBJECTIVE————TO DEMONSTRATE CASE OBJECTIVE—————TO DEMONSTRATE CASE OBJECTIVE—————TO DEMONSTRATE CASE OBJECTIVE—————TO DEMONSTRATE CASE OBJECTIVE————————TO DEMONSTRATE CASE OBJECTIVE——————TO DEMONSTRATE CASE OBJECTIVE————————————————————————————————————											
APPLICATIONEXAMPLE CASE											
APPLICATIONEXAMPLE CASE COMPUTER PROGRAM		3711 10284		PRESSURE	TNATZNOD	TA3H D	SPECIFI				
APPLICATIONEXAMPLE CASE STRGES, SECOND SPOOL						1 2.12		* *			
APPLICATIONEXAMPLE CASE		100			231183008						
APPLICATIONEXAMPLE CASE				*******	**************************************	OGRAMAAA	A9 A3TU9M	OD STARTE	TO DEMON	JECTIVE	90
CYSE NOWBER		66-6666		********	21 SECOND CDOOL	anatz £=~1009	e first s	235AT27-J0	0042 OWI	YKYCIFKIRLICZ:	/U1
								32AD	EXAMPLE	NOI TAD1 JG	46¥
SPOOL NUMBER 2 OF 2	8	CASE NUMBE						1,			
2 20 0 030000 10003					מבע ל 10 ג	שרטטיב אטא	· (
						10003			i i .		

		•		•								
		e e e e e e e e e e e e e e e e e e e		A CONTRACTOR OF THE SECOND						Į.		
3	DATE03-01-6	.8			STAGE VELOC	ITIES					PAGE	<i>:</i>
					FREE VORT						7.490	
c	1	U VU1 T/SEC FT/SEC 828.7 3619.6 050.0 2867.7 271.2 2374.5	1655.7 1655.7	V1 WU1 FT/SEC FT/SE 3980.3 2790. 3311.4 1817. 2894.7 1103.	9 3245.1 7 2458.7	VU2 FT/SEC -972•7 -767•7 -634•1	VX2 FT/SEC 1655.7 1655.7	V2 FT/SEC 1920.3 1825.0 1773.0	WU2 FT/SEC =1801.4 =1817.7 =1905.3	w2 FT/SEC 2446.7 2458.7 2524.2	-0.596 0.000 0.315	
(1	814.9 3679.4 050.0 2867.7 285.0 2349.4	1791.9	4092.6 2864. 3381.6 1817. 2954.8 1064.	7 2552.5	-989.2 -767.7 -627.3	1791.9 1791.9 1791.9	2046.9 1949.5 1898.6	-1804.1 -1817.7 -1912.3	2542.8 2552.5 2620.7	-0.650 0.000 0.329	
C	1	797.8 3756.2 050.0 2667.7 302.1 2319.1	1934.3	4225.0 2958. 3459.1 1817. 3019.9 1017.	7 2654.4	-1010.4 -767.7 -619.0	1934.3 1934.3 1934.3	2182.3 2081.1 2030.9	-1808.2 -1817.7 -1921.2	2647.9 2654.4 2726.3	-0.720 0.000 0.347	

Ĵ	DATE03-01-6	•		TAGE MACH NUMBERS
. (DV1503-01-0			TAGE MACH NUMBERS
(FREE VORTEX
C	STAGE 1	ABSOLUTE NOZZLE EXIT 0.664 0.545 0.473	RELATIVE ROTOR EXIT 0.403 0.404 0.415	
€	2	0.699 0.569 0.493	0.428 0.429 0.440	
		0.740 0.595 0.515	0.456 0.457 0.469	
C				

03*59 - 22*69- 40*89-	71°11- 79°12- 95°12-	28.32 52.64 57.75	62.75 56.00 50.17	184.203	161.552	€€8•€	46 7 . €	#TZ0•8	.	
75*9 7= 03*67 = 6 1* 67=	-10°55 -53°16 -56°86	76.72 04.24 07.05	99°29 00°89 60°49	181.011	79E•871	165•€	6E 5 •E	9*051¢		
24138 530 54,74- 50,64-	ALPHA2	BETA1 DEG 59.32 47.67 53.67	11°55 90°00 10°69 DEC VEDHVI	S ABRA S ABRA NI-OS LTE.OTI	ANNULUS SQ-1N SQ-1N 167.961	BLADE HEIGHT 2 1N 3+380	BLADE HEIGHT 1 10 3.332	MEAN RADIUS IN 8.0214	32AT2 1	
				Xaī	EREE VOR	•				
PAGE 11				четкү	STAGE GEO!				00-10 507.44	

STAGE GEOMETRY

DV1E03-01-08

(DATE03-01-68		PRES	SURES	•				TEMPERAT	URES	PAGE 12
					. 1	FREE VOR	TEX				
	STAGE	PT1 PSIA 55.9 55.9 55.9	P1 PSIA 41.7 45.7 48.0	PT2 PS1A 48.0 48.0 48.0	P2 PSIA 44.8 45.1 45.3	PRS	PRT 1+179	TT1 DEG R 1137.8 1137.8	71 DEG R 1047.5 1075.3 1090.0	TT2 DEG R 1094.3 1094.3	T2 DEG R 1073.3 1075.3
	2	47.4 47.4 47.4	34 • 2 38 • 1 40 • 1	40 • 4 40 • 4 40 • 4	37.2 37.5 37.7	1.278	1.187	1094.3 1094.3 1094.3	998.8 1029.1 1044.5	1050.8 1050.8 1050.8	1026.9 1029.1 1036.2
	3	39.9 39.9 39.9	27 • 7 31 • 4 33 • 3	33.8 33.8 33.8	30.7 30.9 31.1	1.306	1•195	1050.8 1050.8 1050.8	949.0 962.6 998.8	1007.3 1007.3 1007.3	980.1 982.6 983.7

,

(DATE03-01-6	8			S	TAGE PERFO	RMANCE		* * * * * * * * * * * * * * * * * * *		
•	STAGE	LAMDA	DEL H	ETS	ЕТТ	U/CO					
	1	0.288	BTU/LB 152•4	0.618	0.844	0.298					
Carlo	2	0.288	152 • 4	0.595	0.843	0.293					
	3	0.288	152.4	0.572	0.844	0.287					
•					OVERAL	L BLADE P	ERFORMANCE				
(DEL H BTU/LB	UMA FT/SEC	U/CO	U/C01	PRST	PRTT	ETST	ETTT	RET	RES	
	457.4	1050.0	0.188	0.202	1.828	1.674	0.735	0.850	1.007	1.008	
			•	OVERALL TURI	BINE PERFO	RMANCE IN	CLUDING EX	IAUST COLLE	CTOR		
	U/CO 0.183	U/CO! 0.192	PRST 1.888	PRTT 1.775	ETST 0.700	ETTT 0.770					

DATE03-01-	68		ROTOR BLADE ROOT ST	RESS		PAGE 14
STAGE	MEAN RADIUS IN	AVERAGE BLADE HEIGHT IN	STAGE LOAD PERCENT	CENTRIPETAL STRESS PSI	BENDING STRESS PSI	TOTAL STRESS PS1
1	8.0214	3.356	33.3	51618.6	424.7	52043.3
2	8.0214	3.565	33.3	54829•4	399.8	55229•3

33.3

8,0214

3.823

58807.9

372.8

59180.8

DATE 03-01-	٠6	ŧ
-------------	----	---

OVER-ALL TWO-SPOOL PERFORMANCE

	State Paris		F	IRST SPOOL	INLET TO S	ECOND SPO	L EXIT		
DEL H BTU/LB	UMA FT/SEC	U/CO	/ U/CO1	PRST	PRTT	ETST	ETTT	RET	RES
2287.0	1225.0	04104	0.106	9.554	8.747	0.837	0.861	1.069	1.050
				MANIFOLD IN	LET TO SEC	OND SPOOL	EXIT		
DEL H	UMA	U/CO	U/C0*	PRST	PRTT	ETST	ETTT	RET	RES
BTU/LB 2287.0	FT/SEC 1225.0	0.104	0.106	9.685	8 • 866	0.833	0.857	1.064	1.046
					•				
			м	ANIFOLD EX	T TO EXHAU	ST COLLECT	OR EXIT		
								All Comments	
DEL H BTU/LB	UMA FT/SEC	U/C0	U/CO!	PRST	PRTT	ETST	ETTT	RET	RES
2287.0	1225.0	0.104	0.105	9.867	9.273	0.828	0.845	1.058	1.030
			MA	NIFOLD INLE	TO EXHAU	ST COLLECT	OR EXIT		•
DEL H	UMA	U/CO	U/CO!	PRST	PRTT	ETST	ETTT	RET	RES
BTU/LB 2287.0	FT/SEC 1225.0	0.103	0.104	10.002	9.400	0.825	0.841	1.053	1.026
			EX	HAUST COLLE	CTOR EXIT	FLANGE CO	IDITIONS		
AREA SQ-IN	MACH NUM	PT PSIA	P PS1A	1T DEG R	T DEG R				
223.57	0.300	31.9	29.9	1007.3	989.8				